The Utilization of Basic (Phosphate) Slags.

This subject is receiving a very large amount of attention in Germany. It does not appear that the best, or indeed any, method of making use of this material has yet been decided upon, but there is an amount of study and talent being devoted to it which justifies the expectation that very good results will follow. Dr. Wedding, the well-known German metallurgist, read a paper, on October 6 before the *Verein zur Beförderung des Gewerbfleisses*, on the subject of "Phosphorus in the Economy of Nature and of Man," an important part of which paper was devoted to the above subject. Dr. Wedding states that there are now in Germany, in thirteen works, forty-one converters for use in the basic process. Taking the capacity of these converters, and assuming them all to be fully occupied (which at present they are not), and working an average of ten charges per day for 300 days, there would be a production of one million tons of pig iron per year required to keep them going. The amount of phosphorus passing from this iron into the basic slags would be 25,000 tons per year. The importance which this enormous amount of phosphorus would have for German agriculture, if it could all be utilized, may be judged from the fact that the amount of phosphorus at present annually applied to the soil in artificial manures is reckoned at 11,000 tons. Dr. Wedding then proceeded to allude to several of the methods proposed for utilizing the slags. Their use direct is limited to their application to certain moorland districts with acid soils, and though a considerable quantity is already being so applied, and with very good effect, still it amounts to only a small proportion of the whole production. So that some method requires to be sought out, that will be applicable on a commercial scale, to render the insoluble basic phosphate soluble and available for use in ordinary soils. Dr. Wedding then proceeded to speak of several of the methods already proposed or tried, and laid most stress on that of Dr. Frank, to which, and others, we will refer later. Dr. Wedding is so enthusiastic for the great benefits that might result to German agriculture and to German iron mines by the full developement of this utilization of phosphates, that he suggests having protective duties on the importation of foreign iron ores, and so causing the extension and revival of the mining of the phosphatic bog-iron ores of which Germany has such large deposits.

At the close of Dr. Wedding's paper, the subject was taken up by Dr. Frank, above alluded to, who went fully into the question of treating the slags by his own and several other methods. In the first place he reviewed Dr. Wedding's figures as to the amount of phosphorus likely to be available, and came to the conclusion that the quantity had been overstated. Taking average phosphorus in the pig-iron worked as 1½ per cent., as a safe figure, and taking the quantity of iron worked for Germany and Austria together as 750,000 tons, he believes that he is right in assuming 11,250 tons of phosphorus as the annual production. Although this is so much less than Dr. Wedding's figure, it still represents some 56,250 tons of tri-basic phosphate of lime, or more than is now imported from foreign sources and applied as superphosphates; and is of sufficiently great importance in all respects. Alluding to the use of basic slags direct in acid soils, Dr. Frank considers that the good effect noticed is due as much or more, to the free lime contained as to the phosphates, and that this is a very wasteful way of using the slags. He then reviews the methods proposed for preparing a suitable material from the slag, many of which methods show that their inventors "stand on a rather strained footing with the science of chemistry." One great and special difficulty in treating this material is caused by the amount of iron contained. This causes the "reversion," as it is called, to the insoluble form, of phosphate already rendered soluble. Scheibler proposes to use hydrochloric acid. The slags are first calcined in reverbatory furnaces. The action of steam on the contained caustic lime causes the mass to fall to powder by slaking the lime. Shots of metal and undecomposed pieces are separated from the powder by sifting, after which the hydrate of lime is removed as much as possible by levigation. The residual phosphate of lime is now treated with hydrochloric acid, 1.2 litres to 1.5 litres of acid per kilogramme of phosphate, and then a concentrated phosphate is precipitated by a regulated addition of milk of lime The precipitated phosphate contains 35 per cent. to 37 per cent. of phosphoric acid, and is converted into superphosphate by sulphuric acid. The price of hydrochloric acid is proving a bar to the use of this method, the price having so much increased of late, mainly owing to the spread of the ammonia-soda process. The cost is now as much as three or four times what it was a very few years ago.

Dreverman and Thomas have taken another direction, making use of the formation of insoluble combinations of phosphoric acid iron, in order to separate the phosphoric acid from solutions, exactly as is done in the laboratory in similar process. Drevermann uses the insoluble phosphate of iron produced, by decomposing it by means of alkaline sulphide, obtaining on the one hand insoluble sulphide of iron and on the other soluble alkaline phosphate. Thomas, again, treats the phosphate of iron with excess of strong sulphuric acid, forming sulphate of iron insoluble in the strong acid, and obtaining free phosphoric acid mixed with sulpuric acid, this mixture being used for treating other phosphates in the preparation of superphosphate. Dr. Frank also alluded to a proposal made by Thomas, who goes back to a suggestion made many years ago by Lüders and Scheern, to obtain the phosphorus as phosphate of soda, by introducing salt and superheated steam into the converter, or into a Siemens furnace. The chlorine and hydrochloric acid given off are to be utilized: the phosphate of soda is to be converted, by treatment with caustic lime, into phosphate of lime and caustic soda. The iron, after removal of the soda-slag, is to be blown till finished. Dr. Frank says "this proposal opens quite a new perspective, but one would hardly take it in earnest if it were not that the author of it is a man like the inventor of the basic-steel process." The method of utilising the slags which Dr. Frank himself proposes, is based on the use of chloride of magnesium. This is a waste product, in enormous quantity, at the Stassfurt alkali works; and it can also be cheaply prepared from the residues of the ammonia-soda manufacture. By use of a solution of chloride of magnesium, acting upon the basic slags from the converter, all the free lime of the slag can be dissolved out, a corresponding amount of of magnesia being precipitated, but in such a light form that it can easily be washed away. If the slag is melted and run in a thin stream into the solution, this removal of the lime is effected simultaneously with a very complete disintegration. This has been successfully done by melting a quantity of the slag in a special furnace, as of course it cannot be run direct from the converter into the solution of chloride. The free lime, amounting to some 25 per cent. of the slag, being removed in this manner, the solution of calcium chloride so obtained can be treated with caustic magnesia and carbonic acid (calcined dolomite and furnace gases), giving a solution of magnesium chloride again for further use. The residual phosphate, after this extraction of lime, is treated with sulphate of magnesia and sulphate of ammonia, the former obtainable as a cheap bye-product of the Stassfurt Alkali manufature anp the latter as by product of coke, etc., manfacture. The result is to obtain the phosphoric acid as an amfmonio-magnesie phosphate, a very concentrated and nitrogen-bearing material for use as manure. This new material for manure would require to be tested and valued differently from ordinary superphosphates. These latter are the-more valuable the more they contain of soluble phosphate. This new material contains no soluble phosphates, and so would not be valuable by this test. But many years since authorities such as Liebig, Boussingault, and Pierre recognised in the ammonio-magnesic phosphates a very effective manure. Trials are about to be made of it at several agricultural stations in Germany in order to determine its value, and the inventor of this process, which seems to be considered the most promising one in Germany, is hopeful that there will eventually be no difficulty in getting it properly valued in the market.

Railway Construction in Japan.

Nature states that the last four years have been a period of unusual activity in railway constructure in Japan. How much has been done in that period, and is now being done, is not generally understood in Europe. The following statement on the subject is summarized from a paper communicated to the Geographical Society of Toulouse, by Captain Fouque, professor of mathematics in Tokio. The line between Tokio and Yokohama, eighteen miles in length, was opened in June, 1872; that between Hiogo and Osaka in March, 1874, its extension to Kioto in 1876, and a further extension to Otsu, making the total length from Hiogo about sixty miles, in 1879. At Otsu i reached the shores of Lake Biwa. What may be regarded, therefore, as a prolongation of this line is that from Nagahama, at the head of the lake, to Tsuruga, an important harbor on the sea of Japan, a distance of over twenty-five miles. There is thus a direct steam connection (as there is a fleet of steamers on the lake) between Hiogo, on the Inland sea, and the sea of Japan, on the west. On May 25th last a line was finished between the same—Nagahama and Sekigohara with a continuation to Osaki, a total distance of about fifty-five miles, through the center of the province of Mino, one of the most productive in Japan. The last line finished is that between Tokio and Tagasaki, which was opened by the Emperor on June 25, 1884. The length is about sixty-two miles, and it taps the rich provinces of Joshin, Shinshin, and Boshin, the great centers of silk, tea, and tobacco cultivation. There were no serious engineering difficulties on this line, perhaps the most important of any yet constructed in Japan, for it traversed large and fertile plains. Thus the total length of the railways actually constructed in Japan is about 220 miles. Two short lines in course of construction are those between Shinagawa, near Tokio, and Kawaguchi, and one from Tagasaki to Mayebashi, the capital of the silk trade. The latter is only about eight miles long, and may be regarded as complete. Of projected lines, the construction of the following has been decided on, and the work should be commenced by this time; (1) One from Tokio due north through the center of the main island to Awomori, opposite Hakodate, in the island of Jezo. This would be one of the main trunk lines of Japan, and its length will be about 450 English miles. (2) From Takasaki to Ogatchi, the first part of a line which will ultimately reach Yokkaichi, an important seaport on Owari Gulf on the east coast. The length of this will be about 200 miles. (3) From Nyeda, in Shinano province (in the center of the main island), to Niigati, the principal part of the west coast, 150 miles, and two shorter lines intended to connect important town with neighboring ports. It has been decided recently to construct tramways between some of the principal towns omitted in the railway scheme, the first being between Tokio and Kofu, a distance of about 700 miles. The amount of money available for public works of this description is necessarily limited, and the progress is therefore, everything considered, exceedingly rapid.

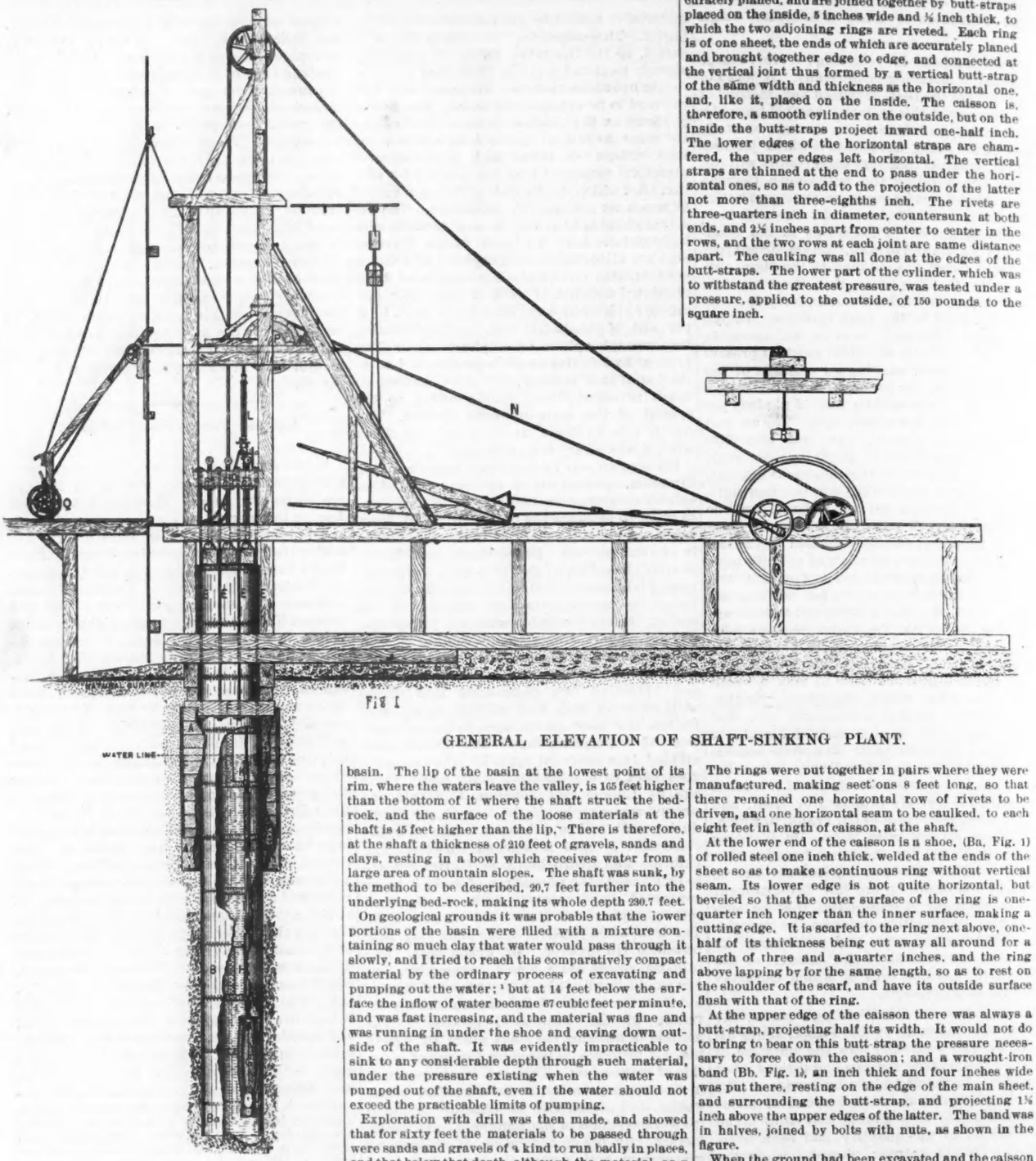


Fig 1

GENERAL ELEVATION OF SHAFT-SINKING PLANT.

A New Method of Shaft-sinking Through Water-bearing Loose Materials.*

BY JAMES E. MILLS, B. S., QUINCY, CALIFORNIA.

In the work of exploring certain gold-bearing gravels in the American Valley, Plumas Co., California, entrusted to my charge by Prof. A. Agassiz, of Cambridge, and Q. A. Shaw, Esq., of Boston, it became necessary to sink a shaft through loose materials containing in some layers large quantities of water, and I have been compelled to devise a new method, which has proved successful and may be of service elsewhere.

The American Valley is a comparatively level tract of about 4,500 acres, surrounded with steep mountain slopes, which rise on the east, south and west to peaks of an elevation about 3,600 feet greater than that of the valley. The floor of the valley is of loose materials—gravels, sands, clays, etc.—and these rest in a rocky basin. The lip of the basin at the lowest point of its rim, where the waters leave the valley, is 165 feet higher than the bottom of it where the shaft struck the bed-rock, and the surface of the loose materials at the shaft is 45 feet higher than the lip.[2] There is therefore, at the shaft a thickness of 210 feet of gravels, sands and clays, resting in a bowl which receives water from a large area of mountain slopes. The shaft was sunk, by the method to be described, 20.7 feet further into the underlying bed-rock, making its whole depth 230.7 feet.

On geological grounds it was probable that the lower portions of the basin were filled with a mixture containing so much clay that water would pass through it slowly, and I tried to reach this comparatively compact material by the ordinary process of excavating and pumping out the water;[1] but at 14 feet below the surface the inflow of water became 67 cubic feet per minute, and was fast increasing, and the material was fine and was running in under the shoe and caving down outside of the shaft. It was evidently impracticable to sink to any considerable depth through such material, under the pressure existing when the water was pumped out of the shaft, even if the water should not exceed the practicable limits of pumping.

Exploration with drill was then made, and showed that for sixty feet the materials to be passed through were sands and gravels of a kind to run badly in places, and that below that depth, although the material, as a whole, was more clayey, there were at intervals strata of loose, open sands and gravels as far as the drill went, which was to 170 feet.[2]

The depth was too great to permit the use of compressed air to balance the pressure of the water. The Kind Chaudron process was not available, for the material would not stand unsupported for more than a few feet, in places not more than a few inches, much less for the whole depth. A caisson must be carried down with the excavation, and be kept pressed against the bottom.

The caisson adopted (B. Fig. 1 of the accompanying drawings) is a cylinder of 55 inches outside diameter, of wrought-iron one-half inch thick, leaving inside diameter 4½ feet. It is made of rings 4 feet long, and the rings come together edge to edge, with edges accurately planed, and are joined together by butt-straps placed on the inside, 5 inches wide and ⅜ inch thick, to which the two adjoining rings are riveted. Each ring is of one sheet, the ends of which are accurately planed and brought together edge to edge, and connected at the vertical joint thus formed by a vertical butt-strap of the same width and thickness as the horizontal one, and, like it, placed on the inside. The caisson is, therefore, a smooth cylinder on the outside, but on the inside the butt-straps project inward one-half inch. The lower edges of the horizontal straps are chamfered, the upper edges left horizontal. The vertical straps are thinned at the end to pass under the horizontal ones, so as to add to the projection of the latter not more than three-eighths inch. The rivets are three-quarters inch in diameter, countersunk at both ends, and 2½ inches apart from center to center in the rows, and the two rows at each joint are same distance apart. The caulking was all done at the edges of the butt-straps. The lower part of the cylinder, which was to withstand the greatest pressure, was tested under a pressure, applied to the outside, of 150 pounds to the square inch.

The rings were put together in pairs where they were manufactured, making sections 8 feet long, so that there remained one horizontal row of rivets to be driven, and one horizontal seam to be caulked, to each eight feet in length of caisson, at the shaft.

At the lower end of the caisson is a shoe, (Ba, Fig. 1) of rolled steel one inch thick, welded at the ends of the sheet so as to make a continuous ring without vertical seam. Its lower edge is not quite horizontal, but beveled so that the outer surface of the ring is one-quarter inch longer than the inner surface, making a cutting edge. It is scarfed to the ring next above, one-half of its thickness being cut away all around for a length of three and a-quarter inches, and the ring above lapping by for the same length, so as to rest on the shoulder of the scarf, and have its outside surface flush with that of the ring.

At the upper edge of the caisson there was always a butt-strap, projecting half its width. It would not do to bring to bear on this butt-strap the pressure necessary to force down the caisson; and a wrought-iron band (Bb, Fig. 1), an inch thick and four inches wide was put there, resting on the edge of the main sheet, and surrounding the butt-strap, and projecting 1½ inch above the upper edges of the latter. The band was in halves, joined by bolts with nuts, as shown in the figure.

When the ground had been excavated and the caisson pressed down until its upper edge was 8 feet below the working floor, the band was taken off, another section riveted on, and the band put on top of the latter.

As the excavation proceeded, the caisson was forced down by hand with screws, reinforced toward the last by a falling weight.

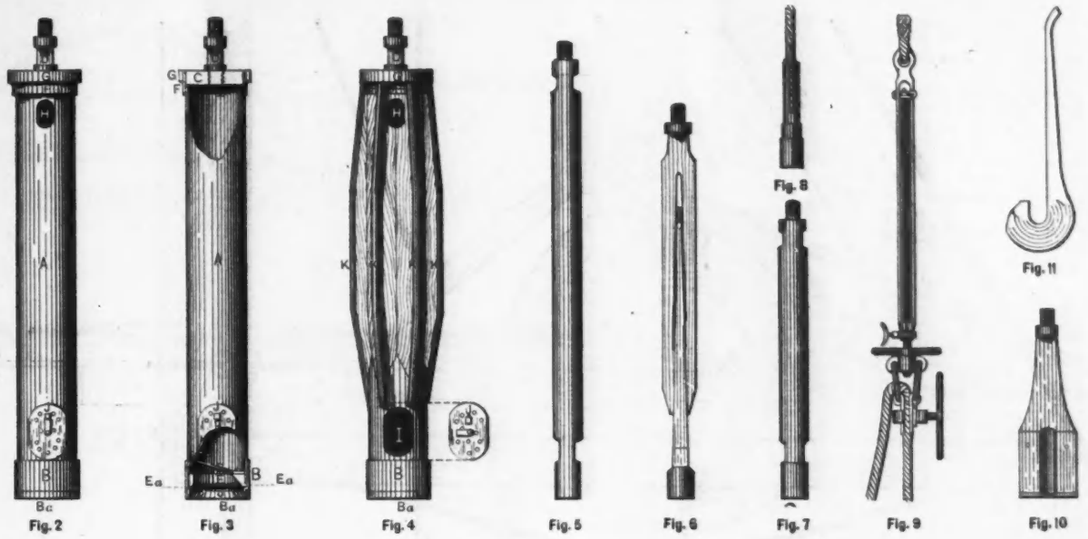
The screws acted directly upon timbers 14 inches square on the end, resting on the band above mentioned. The bottom of the timbers, which rested directly on the band, was shod with 9 inches wide of wrought-iron 1 inch thick. As the thread extended for only about five feet in length of the screws, blocking was put in between them and the lower timbers as the caisson went down, and removed when a new section was put on.

The screws, with their nuts and steps, are shown at C, Ca, Cb, Fig. 1, and need no further description, except that they were of strong cast-iron, called "gun-metal" in Boston, where they were made, and there were anti-friction buttons of hard steel in the steps. They were six in number, arranged, as shown in Fig. 1, in two sets of three each; but for the greatest part of the time only four were used, in two sets of two each. The nuts of each set were fixed into a timber 14 inches

*Read at the Chicago Meeting of the American Institute of Mining Engineers. Illustrations from *Van Nostrand's Engineering Magazine.*

[1] The shaft started for this purpose is shown at A, Fig. 1 of the accompanying drawings. It was rectangular, and had an iron shoe, Aa, Fig. 1, which was pressed down with jack-screws as the excavation proceeded, and plank "cribbing" was built in as the shoe descended.

[2] There were geological data for concluding that the depth to bed-rock was not more than 250 feet.



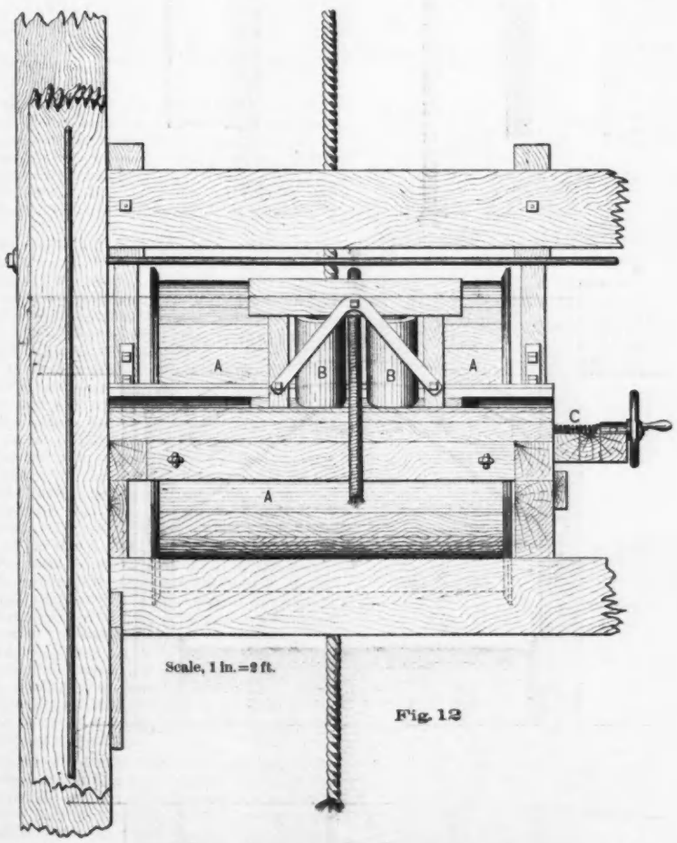


Fig. 12

square on the end (D, Fig. 1), and this was held down against the thrust of the screws by four rods (E, Fig. 1) of round iron, 1¼ inches in diameter, which passed through it and a similar timber (F, Fig. 1) placed under the main shaft-head timbers; the rods having nuts at both ends, and cast-iron washers, a foot square, between the nuts and the surface of the timbers. The shaft-head timbers bore the weight of the hoisting frame, and of a part of the building, and a load of gravel and clay, which was increased from time to time as became necessary.

One or more hydraulic presses, driven by the engine, would do the work much better, and at much less expense, than these screws. The pressure could then be kept even and constant while the excavation was going on.

The excavating was almost wholly done by a modification of the sand pump used in sinking artesian wells, which I call the drill pump. It is shown at G, Fig. 1, and in Figs. 2, 3, 4. It is essentially a cylinder or barrel, with an annular drill at its lower edge, and a valve seated just above. It will be more fully described below. The flat drill shown in Fig. 10, was made to be used in ground too hard for the drill pump, and to break up large boulders, and was tried for these purposes a few times, but to little or no perceptible advantage. The drill pump itself loosened the ground, broke up the boulders when too large to pass through the valve, and raised the material efficiently.

The augur stem (H, Fig. 1 and Fig. 5), jars (I, Fig. 1 and Fig. 6), sinker-bar (J, Fig. 1 and Fig. 7), rope-socket (K, Fig. 1 and Fig. 8), temper-screw and clamp (L, Fig. 1 and Fig. 9), and wrenches (Fig. 11), were the same as are used in the oil regions of Pennsylvania, where the tools were made, except that the auger-stem and sinker-bar were made shorter, and the necessary weight was secured by increased diameter, because the distance between the floor and the sheave (M, Fig. 1) was too short for tools of ordinary length.

The drill pump could not have a diameter near that of the shaft, like the sand pump of artesian wells, nor could it extend (like the drills used in artesian well-boring, and in the Kind-Chaudron process) across the shaft, so as to be brought to bear on the whole area of the bottom by being turned around. It was therefore hung from a movable point, so that its position could be shifted, and it could be placed over and dropped on to any part of the bottom of the shaft. This could hardly be accomplished with the walking-beam ordinarily in use in artesian well-boring; and the drill-rope, therefore, instead of being suspended from such a beam, was connected through the clamp and temer-screw with another rope (N, Fig. 1), which was attached by a loose wooden eye (O, Fig. 1) to the wrist-pin of the gear wheel through which the drilling motion was imparted to to the tools.[3]

This latter rope, on its way to the gear wheel, passed over a rolling horizontal drum (P, Fig. 1, and A, Figs. 12, 13, 14), and between two vertical rollers (B, Figs. 12 and 13). The drum could be moved forward by a winch (Q, Fig. 1), and run back by a weight (R, Fig. 1), and the vertical rollers could be moved to right or left by a screw (C, Figs. 12, 13 and 14), and so the point of suspension of the tools could be placed over any part of the floor of the shaft where the drill pump was to work.

The hoisting-frame and machinery were the same that were put in and are now used for ordinary hoisting and pumping, except that for pumping, a larger gear wheel has been put in the place of the one which imparted drill motion to the tools. The winding-reel (S, Fig. 1) was operated by friction gear in raising the tools and load, and controlled by break in lowering them.

The tools were let down and the connecting rope attached by the clamp La, Fig. 1, and put into place by moving the drum and rollers; the main rope slackened above the clamp, and the machinery started, giving the lift-and-drop motion to the tools. When the drill pump was loaded, the connecting rope was unclamped from the main rope and disconnected with its driving wheel by slipping the wooden eye from the wrist-pin, the drum moved back, the tools raised, and the drill pump emptied.

The drill pump and its parts are shown at G, Fig. 1, and in Figs. 2, 3, 4. The whole length of the pump is 7 feet and 7 inches, besides the connecting pin (D, Figs. 2, 3, 4), which extends 10½ inches above the head. The main barrel (A, Figs. 2, 3) is of wrought-iron, ¼ inch thick, with welded vertical seam, is 7 feet 1 inch long, and its inside diameter is 1 foot. The shoe (B, Figs. 2, 3, 4) screws on to the barrel at its lower end. Its cutting edge is formed by a beveled steel ring (Ba, Figs. 2, 3, 4), which is fastened with set screws to the iron of the shoe. The valve seat (E) is held in place by a projection Ea, Fig. 3) at its lower edge placed between the shoe and the lower edge of the main barrel. The head (C, Fig. 3) consists of a wrought-iron plate, 3 inches thick, held to the barrel by a band (F, Fig. 3) screwed on it and on to the outside of the barrel. The joint was made more firm by shrinking an iron ring (G, Figs. 2, 3, 4) on to the band over the edge of the plate of wrought-iron; and to make the joint more secure, a similar wrought-iron plate should be put into the upper end of the barrel, and a ring shrunk on to the band over its edge. The pin (D, Figs. 2, 3, 4) by which the drill pump is attached to the auger-stem, is screwed into the iron plate of the head, as shown in Fig. 3. An opening (H, Figs. 1, 4) below the head let out the air as the drill pump descended into the shaft, and the water above the load during the drilling. The load was taken out of the barrel through the opening (I, Fig. 4) just over the shoe, with a small hoe made for the purpose. The opening was closed by the gate (J, Figs. 2, 3, 4). To prevent hitting the butt-straps of

[3]Such a connecting rope is in common use in sinking small artesian wells by horse-power, but passes over a sheave fixed in position.

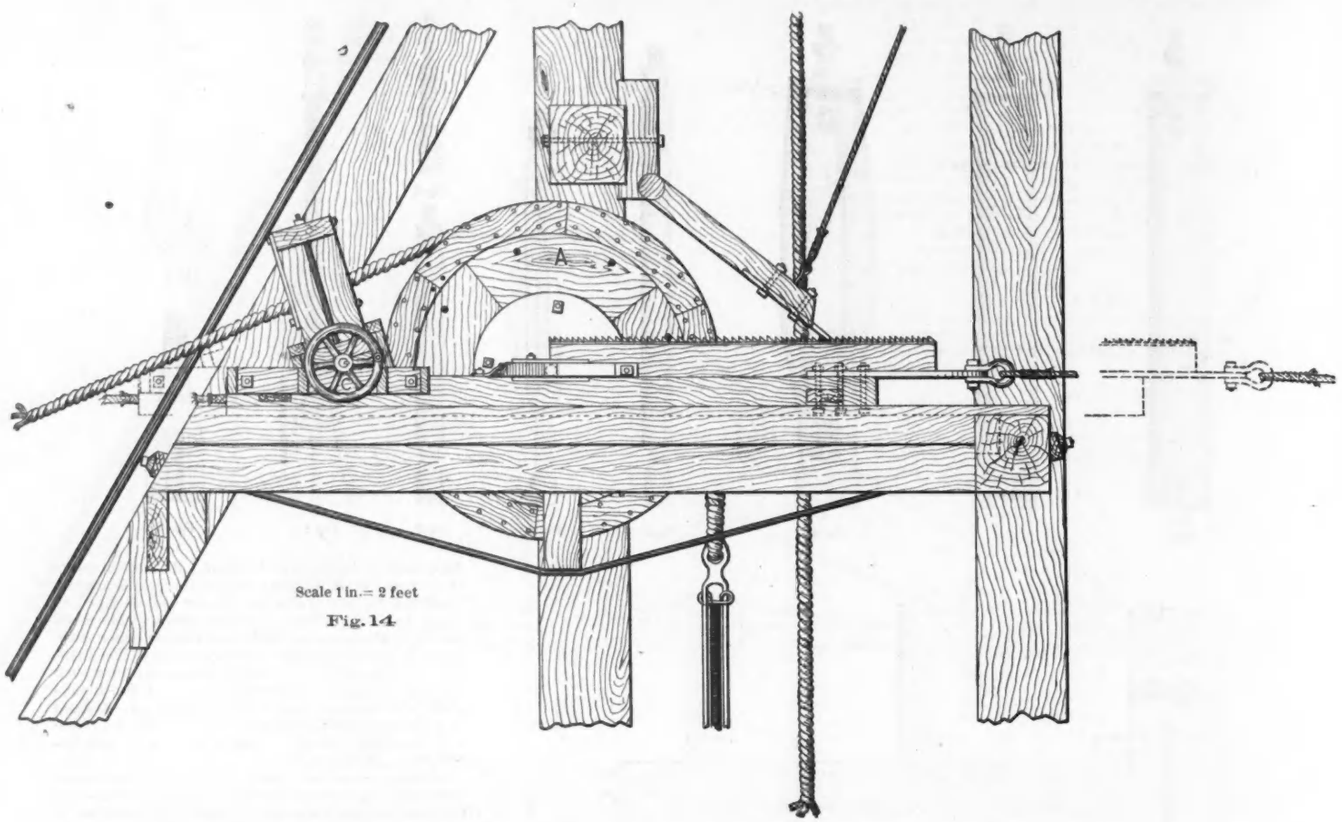


Fig. 14

the caisson with the sharp edge of the shoe, and the upper edge of the pump, the guard of wood and iron (K, Fig. 4) was put on. The weight of the tools as suspended was:

Pump	872½ lbs.
Auger-stem	692 "
Jars	385½ "
Sinker-bar	436 "
Rope-socket	54 "
Total	2,440 lbs.

To this is to be added the weight of the rope, which increased with the depth. But the weight of the rope, rope-socket, sinker-bar and upper link of the jars added nothing directly to the force of the downward blow, and aided it only by overcoming the friction of the rope in passing through the water. In fact the sinker-bar was omitted for the greater part of the distance, but toward the last seemed to be of some service, especially when the water was thick with mud. The wood of the pump guard weighed about 72½ pounds when water-soaked, not far from the weight of the water it displaced, and neither increased nor lessened the force of the blow materially. There remained of the pump 800 pounds of iron, which, with the 692 lbs. of the auger-stem and the 193 pounds of the lower link of the jars, made a weight of iron 1,690 pounds. This, falling through water, is equal to 1,472 pounds falling through air, with some deduction to be made for the difference between the frictional resistance of air and water, and some further deduction for the greater weight and frictional resistance of the water when heavily charged with mud in suspension. The weight and consequent force of the blow increased as the pump became loaded, and at times the weight reached nearly the equivalent of a ton falling through air.

The lift and drop of the tools when drilling which was found best fitted for safe and efficient working of the machinery was 2 feet, and the number of drops 32 per minute.

When the drilling was going on, a man stood with his hand at the temper screw to let down the tools by turning the screw as the drill pump excavated, fast enough to render the blow effective, but not enough to permit the tools to topple over against the caisson. He could judge of the blow by the jar at his hand.

The length of time required to load the drill pump varied with the character and compactness of the material; but it was generally kept in motion at the bottom 20 minutes. The raising and lowering, connecting and disconnecting at the clamp and wrist-pin, taking out the gate and the load, and replacing the gate, took about ten minute more, making 30 minutes to each charge, or two charges to the hour.

The area of the cross section of the caisson, including its wall, is 16.5 square feet, and the area of cross-section of the drill pump 0.785 of a foot, or about 1st of that of the caisson. The material in the drill pump was less compact than in place at the bottom of the

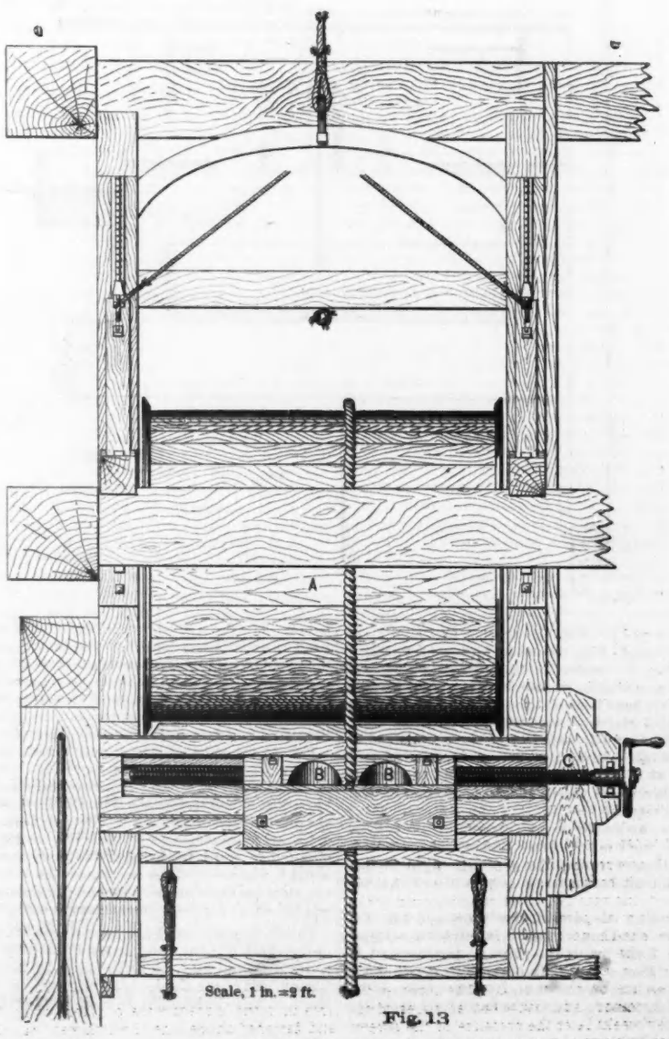


Fig. 13

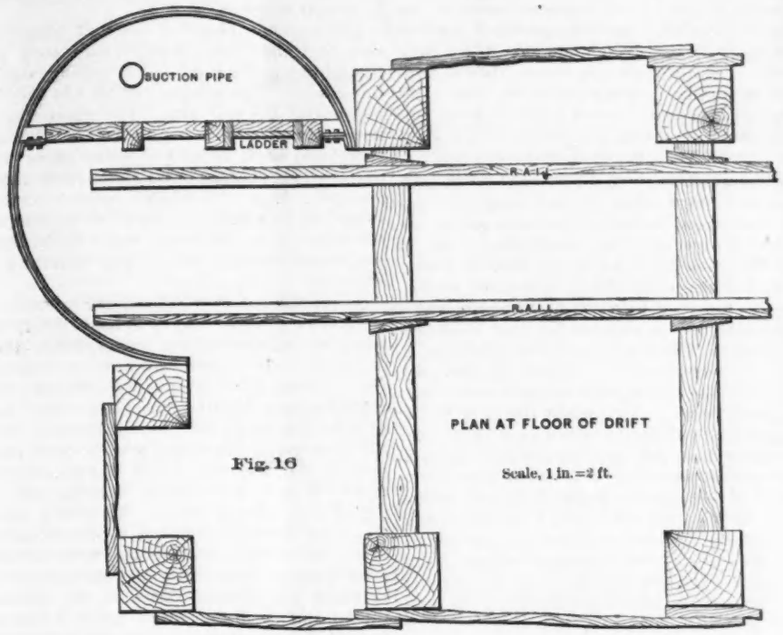


Fig. 16

shaft. A load of 1 foot in depth in the drill pump would lower the bottom of the shaft about ¼ inch, and a load—quite often attained—of four feet in depth of the drill pump would lower the bottom of the shaft 2 inches, and 20 such loads in a day of ten hours would lower it 40 inches. The latter rate of sinking was sometimes attained, but the average rate was much lower.

The caisson was put into the rectangular shaft A, Fig. 1, which had already been sunk 14 feet, and the space outside of the caisson and within the rectangular shaft filled with clay. The only settling about the shaft observable at the surface was within the rectangular shaft. It was but little, and as it took place, clay was added at the top.

Before the work was fairly started, some days had been spent in becoming accustomed to the work and making needed alterations in the tools; and during this time the caisson had been sunk 5 feet, or to 19 feet from the surface. The shaft and caisson were sunk the next 59.6 feet, or to 78.6 feet below the surface, in 41 working days of ten hours each, or at the rate of 1.45 feet per day. This included the time spent in putting on new sections to the caisson, which was 13.6 days.

At this depth (78.6 feet below surface), the water was taken out of the shaft. The material passed through had become more compact from about 60 feet downward, and I had expected to sink from here by ordinary methods; but the inflow of water at the bottom, which was at first 3.2 cubic feet a minute, increased in about four hours to 5.3 cubic feet per minute, and it was plainly best to continue on with the method that had succeeded so well thus far. The caisson was in good condition, whole and water-tight but slightly curved from end to end, so that the center at the bottom was about 4⅝ inches from a plumb-line dropped from the center at the top.

After a delay of some months in getting more sections of caisson, work was resumed, and the shaft was excavated and the caisson sunk 102.4 feet further, or to 181 feet below natural surface in 91 days of ten hours each, actually spent upon the work. This included 22½ days spent in putting on new sections of caisson.

To this point the working force consisted of one skilled man to tend the engine, and two skilled drillers, and one or two laborers a portion of the time to aid at the screws, besides the engineer in charge. The working time was limited to ten hours a day, because the work was novel and it seemed hardly safe to have it go on in my absence, and also because I wished to observe carefully the character of the deposits passed through. The principal danger was that the excavations might be carried too far ahead of the caisson, and so cause caving and loosening of the material about the caisson. This would be obviated if hydraulic presses were substituted for screws as above suggested.

At the depth now reached (181 feet), the effect of the curve in the shaft began to be seriously felt; for the drill pump hanging vertically from the top could not be made to drop on to all parts of the floor, and left untouched a crescent-shaped area under the over-hanging portions of the cylinders. The material thus left had to be partially caved in and partly crowded in by increased pressure on the caisoon. The force at the screws was increased, and consisted at times of six men; and a few weeks later the pressure of the screws was reinforced by blows of a ram consisting of a stick

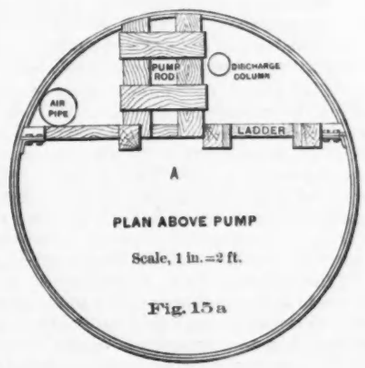


Fig. 15a

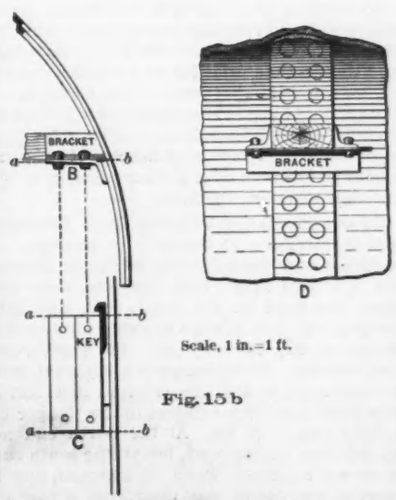


Fig. 15b

of timber 21 inches square and 22¼ feet long, weighing, with eye-bolt, nut and washer by which it was suspended, 2,280 pounds. This was dropped two feet, thirty times a minute, on to a timber placed between the timbers on which the screws acted directly and the upper edge of the caisson.

Including the time consumed in putting on the ram, and putting on new sections, it took 23.5 days to sink the caisson the next 15.5 feet, to the depth of 196.5 feet below the surface. The excavation was 5.7 feet deeper.

The water was then again bailed out of the shaft. The curve of the shaft now left nearly half of the floor outside of the direct blow of the drill pump, and in the area thus out of reach were boulders of hard material and flattened shape, one of which was 0.44 cubic foot in bulk. These materials on the higher part of the floor were cut down by hand and thrown to the other side where the drill pump could reach them, and then taken out by the drill pump. In all, about four hours of time was spent in excavating by hand, and this was all the excavating done by hand in sinking the shaft.

At the lower edge the shoe showed a slight bulge, extending over about nine square inches of area, and projecting inwards about one-half inch at the middle of the bulge. Otherwise the caisson was unimpared.

The inflow of water was varying, but at first averaged about 1.21 cubic feet per minute, and increased to about 2.34 cubic feet.

The next 13.5 feet brought the caisson to the surface of the bed-rock, at 210 feet below the natural surface. It took 23 days, including the time (4 days) spent in putting on two sections of caisson.

The bed-rock was a friable and rather soft clay slate, and was easily excavated with the drill pump. The caisson was sunk 20.7 feet in the bed-rock, to the depth of 230.7 feet below natural surface. To sink this 20.7 feet in bed-rock took 46 working days, including all the time of excavating, pressing caisson and putting on the sections of caisson.

After a month's delay the water was bailed out of the shaft. The caisson was in good condition, but somewhat deformed at its lower edge—not enough, however, to materially impair its usefulness. I think this deformation was caused by the bed-rock swelling and pressing against it unevenly.

The inflow of water varied, but averaged about 3.6 cubic feet per minute, or less than 5½ per cent. of the inflow at 14 feet from the surface. It came through the bed-rock clear, and was therefore not enlarging its channels.

The shaft had not only been sunk successfully through 210 feet of loose materials and 20.7 feet of rock, but the caisson had shut out the water of the upper loose gravels and sands and of the lower layers of similar materials had prevented the running in of sand, and left, to be contended with at the bottom, only a small inflow of clear water coming through rock.

A partition with ladder attached was put in as shown in Fig. 15, dividing the shaft into hoisting and pumping compartments, and a common "jack-head" pump, of 5 inches diameter and 4 feet stroke, was carried down at the same time with the partition.

A portion of the bed-rock was found loose and running, and where it was so, rods of round iron one inch in diameter and three feet long, pointed at the outer end, were driven out into the bed-rock through holes drilled through the shoe 2 inches above its lower edge, and 2 inches apart from center to center, and into the bed rock as far as the rods were to go.

The shaft was then sunk by hand four feet below the lower edge of the shoe for a sump, and secured by staves driven around iron hoops. The staves were started about a temporary hoop of outside diameter 3 inches less than the inside diameter of the shoe, but the other hoops have the same inside diameter as the caisson, and when the staves were all in they were pushed outward and upward by the outer surface of the shoe so as to rest against it at their upper ends.

A row of iron rods like those before mentioned were driven over the space where the opening for the drift or gallery was to be made, and just above the second butt-strap counting from the bottom. The opening was cut out through the caisson between the lower edge of this butt-strap and the upper edge of the shoe. The plan of the opening and the timbers at the beginning of the drift are given in Fig. 16.

As long as the work is one of exploration, kibbles will answer for hoisting; but when necessary, a cage can be used to occupy the whole cross-section of the hoisting apartment, and when still more hoisting room is needed, another shaft can be sunk near by, and one of the two given up wholly to hoisting, and the other left for pump, ladder way and ventilating pipes; and, indeed, the capacity can be increased to any required extent by sinking a group of such shafts near one another, but with space enough between them to prevent breaking down or disturbing the ground between them while sinking. Shafts much larger than the one here described, indeed, of any ordinary size, could be sunk by the same method.

All the serious difficulty which this method of sinking encountered was caused by the curve of the caisson: and this is an avoidable difficulty. The use of hydraulic presses, as above suggested, would obviate the danger of excavating too far below the foot of the caisson, and would reduce the working force to three skilled hands.

The method is not only an efficient one where ordinary methods would fail, but it is also an economical, rapid and safe method of sinking through water-bearing, loose materials, and could be applied to sinking caissons for bridge piers and other foundations, as well as to mining shafts and large artesian wells.

I have given above the time actually spent in sinking. The work was not, however, done continuously, but in intervals of time spent partly in waiting for new sections of caisson to be made and transported to the ground, but principally caused by delay in ordering them. The drilling began August 21, 1882, and ended November 29, 1883. The tools were contracted for in March, 1882, and at the same time 80 feet in length of the caisson, with shoe, screws, etc. The remaining

sections of caisson were ordered in several lots. The reason for not obtaining enough to go to the bottom after the experience of a few feet had proved the efficiency of the excavating tools, was the lack of data for judging of the friction to be encountered. If the caisson had been perfectly vertical, I could now present definite data for determining the friction to be overcome under similar conditions; but on account of the curve in the shaft the necessary friction on the outer surface of the caisson cannot be separated from the added resistance of the materials at the bottom which were not reached directly by the drill pump, and I can therefore add little on the subject to what is above shown, namely, that to the depth of 130 feet the friction on the outer surface of such a caisson carried through such materials is overcome with a pressure easily applied and safely within the endurance of a wrought-iron cylinder, having the thickness of iron proportioned to area of its cross-section as in the one above described, and having a shoe of rolled steel, proportioned as the one described.

Caisson-Sinking at the B. & O. Bridge, Havre de Grace, Md., (Caisson No. 8.)

Written for ENGINEERING NEWS.
BY COL. WM. M. PATTON, ENGINEER IN CHARGE.

(Continued from page, 234.)

Caisson No. 8 was commenced Dec. 10, 1883, launched, March 21, 1884, launching weight being 572,184 lbs.; commenced concreting crib, May 20; caisson finally located, June 3, resting on bottom at low-tide with cutting-edge 28.95 feet below low water; air let into caisson, June 9; commenced pumping out material, June 12, and concrete in crib completed, June 30, with 2569 cubic yards in place, an average of 61 cubic yards per day. The yield per barrel of cement was 0.91 cubic yards, the proportions being 1 part cement, 2 sand, with broken stone screened.

With the cutting-edge 47.54 feet below low-water, the weight of timber, iron and concrete was 11,059,740 lbs. The masonry was commenced July 3, and continued until July 14, at which time it was stopped until the caisson rested upon the rock: this stoppage of masonry was necessary as the caisson was sinking gradually and continuously without any reduction of the pressure. With the total weight at 12,513,791 lbs., air-pressure at 25 lbs., and buoyant effect of air, 8,314,956 lbs., the excess of weight was 4,176,835 lbs.; this would usually represent the frictional resistance; in all the other caissons, where reduction of pressure was required, the material was carefully cleaned out from under the center truss and cutting-edge, leaving no resistance other than friction to be overcome. In this Caisson No 8, owing to the comparatively small frictional resistance, there was only a partial cleaning out, and at each such cleaning the caisson gradually settled until an additional bearing combined with the friction, was sufficient to counterbalance the weight. This excess weight was gradually diminished as increased depth was reached, no great additional weight being placed upon it and the air pressure being necessarily increased as the caisson sunk. On Aug. 5, the air-pressure was 35 lbs., the cutting-edge 74,-99 feet below low-water, weight of timber, iron concrete and masonry, 13,171,071 lbs., and buoyant effect of air, 11,640,938 lbs. This would leave an excess of weight of only 1,530,133 lbs., an amount easily supported by the friction on the sides and by the material under the cutting-edge and the center truss.

At the above date the caisson was found to be resting on the rock around the N. W. corner, and borings in other locations showed the rock at varying depths below the cutting-edge, the greatest distance being about 12 feet. Considering the enormous weight and the danger of a failure of air-pressure, blocking was ordered to be placed at various points, this blocking resting upon sills from 6 to 8 feet long so as to increase the bearing and prevent any tipping tendency in the caisson. The rock was then blasted at the higher points. It was intended that the blocking mentioned should not be wedged so tight as to support much of the weight, but it was placed in position to stop the sinking of the caisson should this latter commence to settle from any cause. It was considered a wise precaution at the time, but subsequent events proved this blocking unnecessary and it was not resorted to in sinking caisson No. 9, under similar conditions.

An examination about the date named showed that only a high ledge of rock near one corner had been reached, the cutting-edge at points being several feet above the rock. It was determined to blast off the rock to a uniform bearing, but the best method of accomplishing the end in view, an unquestionable foundation for the caisson, required considerable study. The general practice would be to chip of the rock and sink the caisson inch by inch until the cutting-edge found a rock bearing at all points. But, while the B & O Co. was determined that the work should be done in a thoroughly safe and substantial manner without stint of money, it at the same time expected of its engineers as rapid a prosecution of the work as was consistent with safety and permanence. Had an open caisson or cofferdam been used; sunk by added weight, there would have been no hesitation on the parts of the engineers in levelling off with good concrete or rubble masonry, provided the rock did not lay in slopes likely to cause slipping: or ample precedent might have been followed and piles driven to the rock. Either method would have been safe though the latter would hardly have been as permanent as was desired.

It was finally determined, after careful study of the conditions, to reach the rock by the most economical method, blast when necessary to render failure by slipping impossible, and to fill up with good concrete. The method of proceeding under the novel circumstances had to be considered; to excavate the entire area was impossible owing to the enormous weight and the eminent danger of a blow-out. The ultimate result of this latter accident could not be measured; in a loose sandy soil, a blow-out is not likely to be attended with any but the immediate danger, for as soon as the water and sand flows in sufficiently to cover the cutting-edge, the escape of air is stopped and the danger is practically over. But the original borings at this point showed that the bore-hole would remain in this stiff and compact material for an unknown length of time, and the character of the material on the exposed faces below confirmed this feature. Judging from these points at Caisson No. 8, a blow-out once formed, any increase of pressure would be followed by a further escape of air through the same opening.

Upon consultation with the Chief Engineer it was determine to concrete in sections. A section across the north end was to be cleaned out first and filled with concrete, then the same was done for the south end, and this method repeated, always working *towards* the center of the caisson, until the foundation was secured. This plan gave a constant and good support under the caisson, and left a minimum of surface exposed to the danger of a rapid escape of air. At the north end no trouble was experienced, but at the south end there was a greater depth of material, and a layer of quicksand was uncovered a foot or two above the rock. This sand flowed freely and rapidly when exposed and undermined the compact material above, causing sometimes a breaking off for a considerable distance outside of the caisson; this latter action was always followed by a rapid escape of air as the contact between the material and the side of the caisson was rendered imperfect. In such cases nothing was to be done but to commence concreting at once to avoid further trouble and close up the avenues for the escape of air. These conditions were continually reoccurring and both contractor and engineers were under constant mental strain, and day and night anxiously watched the work.

This alternate cleaning out and concreting was continued until finally the work was brought up to the level of the cutting-edge of the caisson, The caisson settled 0.95 feet between Aug. 5th and 25th. The concreting in the air-chamber was commenced Aug. 17th, and completed Sept. 12th; 1085 cubic yards were required, an average of 41¼ cubic yards placed per day. The proportions were 1 cement, 2 sand, and the yield per barrel of cement was 1.49 cubic yards; boulders, stone blasted out, etc., were bedded in mortar and estimated as concrete.

On the site of this caisson the attempt at submarine blasting had been made before the work of caisson-sinking commenced. Only one shot had been fired however; on reaching the rock with the caisson it was thought that this had been shattered as large and small angular fragments were found detached from the main mass. This shot was no doubt effective as the rock presented abrupt, vertical faces. Within the caisson blasting was resorted to; around the N. W. corner about three feet was thus removed by small charges of black powder. The holes were covered, after tamping, with plank and dirt and in no case was any damage done to the caisson, though the gases developed made it uncomfortable for the workmen for some time and to that extent retarded the work.

Immediately overlying the rock were found logs, drift-wood and branches of trees, in some places thickly matted together; these must have lodged there and subsequently have been covered by the existing deposit. Numbers of logs were found at various depths in the mud on the way down; these had to be cut out, and with a few exceptions, all the timber found in sinking was in a more or less decomposed state.

DATA FOR CAISSON NO. 8.

Depth sunk below low-water	76 ft.
" to lowest point of rock	88 34/100 "
Total material excavated (little or no inflow)	189,578 cu. ft.
Total timber in caisson	281,540 ft. b. m.
" " " crib	219,680 " "
" " " coffer-dam	85,759 " "
Aggregate timber	586,979 " "
Concrete in crib, shafts, etc	2,581 cu. yds.
" " air-chamber	559 "
" below cutting-edge	526 "
Aggregate concrete	3,666 "
Number of barrels cement in concrete	3,553
" " " grouting-deck	73
Total barrels of cement	3,626
Yield in concrete per barrel	1 1/30 cu. yds.
Average rate of sinking per day	1 59 ft.
Iron screw bolts	31,026 lbs.
" drift bolts	44,861 "
" spikes	10,039 "
Cast washers	3,235 "
Aggregate iron used	89,161 lbs.
Iron per 1,000 feet b. m. of timber	152 "

Early History of the Philadelphia and Columbia R. R. Opened in 1834.

The following matter relating to the early history of the Philadelphia and Columbia R. R., now part of the Penna. R. R., is from a correspondent of the Phila. *Press*:—

SIR:—As I am now, perhaps, the only one left of the original builders of the old Philadelphia and Columbia Railroad, of Pennsylvania, I think a brief history of that time may be of interest to many of your readers.

In the winter of 1825-6, Major Wilson, C. E., returned from England, where he had been sent by the State, bringing with him plans and details of railroad construction as then adopted in England, and which I will describe hereafter. In 1826 two corps of Civil Engineers were put on the survey; one at Columbia, in charge of Assistant Engineer Samuel Taylor, to work eastward, the other in charge of Assistant Engineer Edward F. Gay, John Edgar Thompson and Brinton Moore, second and third assistants respectively. The latter party began operations at Broad and Callowhill streets, following from Bush Hill, the course of the original Pennsylvania Canal bed to what was then called Pratt's Garden, thence crossed to the west side of the river. It was

here that the inclined plane was built, running from the foot of Columbia Bridge up to what is now known as Belmont Mansion. It was 2800 feet long. Before the completion of the survey, Mr. Thompson resigned to accept a position as chief engineer of a projected line in the south, and Brinton Moore succeeded him as second assistant.

The survey completed, work on the road commenced in April, 1827. The course of the road necessitated heavy embankments and deep cuttings, with maximum grades of about 45 feet per mile. One cutting alone, that of the limestone ridge through Brackbill Farm, east of Leamen Station, consumed 17,000 pounds of blasting powder. Contracts were let in a few days for grading nearly the entire length of the road, and the method adopted was about as follows: After the road had been brought to grade, two ditches, 30 inches deep by 30 inches wide, were dug for each track, the bottom covered with 6 inches of fine broken stone, rather smaller than an egg, and well beaten down. To break this stone, hundreds of men, women and children were employed, and paid from 15 to 30 cents per bushel, according to quality. In the place of ties, blocks of stone were used, and placed 3 feet from center to center and brought to grade. Considerable difficulty was had in getting a suitable stone for this purpose but a good solid sandstone was eventually found at Peter's Mountain 22 miles north of the nearest point of the road, and 67 miles from the eastern end. The stone was quarried in blocks about 22-inches square, twenty blocks made a load for a six-horse team; this will give some idea of the immense labor involved. These blocks of stone were then partly filled in around with small stone, in accordance with the English practice. Two holes, 1¼ inches in diameter by 6½ inches deep, were drilled into each stone, and a locust pin, with a ¾ inch hole bored through the center, put into each hole. A piece of heavy canvas, rather larger than the bottom of a cast-iron chair, was stretched over these pins, The chair was then put on and secured to the stone block by pointed iron pins, 7 inches by ¾ inch, driven through into the locust pins.

At that time the T-rail had no base, but was set between the jaws of the chairs and keyed by a 7 inch tapered iron wedge, driven in on the inside of the rail. Great trouble was caused by the expansion of the rails, by which means the wedges got displaced, and when at night the rails cooled, were all loose, so that trackmen had to go along every morning and tighten them up. One part of the line was constructed with stone slabs 6 to 8 feet long, 8 inches thick and 18 inches wide, and brought up to grade by the use of the pick. To these slabs ¾ inch strap bars were secured by spikes 18 inches apart. This part of the line by the majority of people was considered almost indestructible, and looked upon as a great work; but Mr. M. W. Baldwin gave it as his opinion that the track would soon settle with the weight of the engines. This proved to be the case, for in less than six months the track settled and that part of the line was abandoned for sometime to be rebuilt with a wooden rail, 5 inches by 7 inches of Carolina yellow pine. The contract for the rails stipulated that they were to be as full of turpentine as possible.

Notwithstanding very strong opposition, the work progressed, and the line was eventually opened for travel July 4, 1834, one part being operated by locomotives, the other by horses. Fortunately, this was a State enterprise, and opposition went for nothing. There were two trains run on the opening day, each train consisting of thirty four-wheeled cars, each car seating sixteen persons, eight on a side. Governor Wolf was one of the first passengers. Mr. Baldwin received an order for twelve locomotives about this time, and the State imported seven English engines weighing seven tons each. The English engines proved failures and would not haul more than three four-wheeled cars over the forty-foot grade on the Valley Hill and were finally abandoned, while the Baldwin nine-ton engines always drew fifteen loaded cars up the same grade.

The farmers took every means to oppose the railroad, declaring that if locomotives were used their trade in horses would be ruined. A curious incident is here worth reciting. One mile East of Leaman Place a farmer named Slaymaker, whose barnyard was at the foot of a thirty foot embankment, had a 3-year-old bull, that showed its disapproval of railway matters by bellowing in the most unearthly manner at each train, much to the amusement of the passenger. I had occasion to go to Parkesburg early one morning, and with this intent took the 4 o'clock early freight, which was made up of twelve open cars each loaded with four hogsheads of whisky, manufactured by Benjamin Herr, of Manor Township, Lancaster Co. Slaymaker's bull heard the engine coming, got on the track and headed for the enemy. I was on the engine at the time and feared going over the embankment. I called to the engineer to open the throttle wide. The engine darted forward, and the bull met the enemy sooner than expected, and was hurled to the bottom of the embankment. Cowcatchers were not in use then; simply a bumping block. Ever after the bull would shake his head, bellow, but give us a wide berth. This incident was so important at the time that the Jackson Convention at Chambersburg, after denouncing the railroad, declared that Joe Ritner and Slaymaker's bull were opposed to locomotives.

I might add that the old Portage Railroad was built in much the same way as the Philadelphia and Columbia, and experienced similar troubles.

It is a great pleasure to be able to look back and compare the road then with the now perfect and well-equipped system of the Pennsylvania Railroad Company, and I feel proud of what I have seen. Nor would I have Mr. Baldwin forgotton, for it was he who made the first really successful engines in this country, and established thereby a world-wide and lasting reputation.

HENNRY WILLIS.

Battle Creek, Mich.

The Theory and Calculation of Earthwork Slopes.*

Written for ENGINEERING NEWS.

BY MANSFIELD MERRIMAN, M. AM. SOC. C. E.
Prof. of Civil Engineering at Lehigh University.

Continued from Page 247.

14. A CURVED BANK.—The preceeding articles clearly show that the angle of slope ϕ of a bank of cohesive earth increases as its vertical height h decreases, and conversely that as h becomes greater ϕ becomes smaller. It would hence appear that the upper part of a bank may be steeper than the lower part and its liability to rupture be the same throughout. To determine the form of such a curve let D in the figure be any point upon it whose ordinate Dd is y. Let $D\ M$ be the weakest plane making an angle x with the horizontal. The prism of which $A\ D\ M$ is a

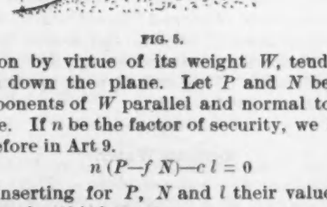


FIG. 5.

section by virtue of its weight W, tends to slide down the plane. Let P and N be the components of W parallel and normal to the plane. If n be the factor of security, we have as before in Art 9.

$$n\,(P - f\,N) - c\,l = 0$$

By inserting for P, N and l their values in terms of x, this becomes

$$n\,W(1 - f\cot x) - c\,y\,(1 + \cot^2 x) = 0$$

The value of W for a prism one unit in length is found from the difference of the areas $d\,D\,M$ and $d\,D\,A$, or if S represent the surface $d\,D\,A$.

$$W = w\,(\tfrac{1}{2} y^2 \cot x - S)$$

By inserting this the equation of stability becomes

$$n\,w\,(\tfrac{1}{2} y^2 \cot x - S)(1 - f\cot x) - c\,y\,(1 + \cot.^2 x) = 0 \qquad (20)$$

This expression equals zero for the weakest plane, but for any other plane its value is less than zero. Hence it must be a maximum with respect to x or $\cot.x$, and its first derivative must vanish. Thus we have also

$$n\,w\,(\tfrac{1}{2}\,y^2 \cot x - S)\,(-f) + n\,w\,(1 - f\cot x)\,(\tfrac{1}{2}\,y^2) - 2\,c\,y\cot z = 0 \qquad (21)$$

By eliminating $\cot.x$ from (20) and (21) the following value of S is found

$$S = \frac{y}{2\,n\,f^2\,w}\left(n\,f\,w\,y + 4\,c - 2\sqrt{2\,c\,(n\,f\,w\,y + 2\,c)\,(1 + f^2)}\right) \qquad (22)$$

and this is the practical equation of the required curve, S being the area between the curve and any ordinate whose value is y.

For example let it be required to construct a curve of equal stability in a bank of 40 feet height with a factor of security of 1.5, the earth having a natural slope of 31°, a vertical rupturing depth of 5 feet, and weighing 100 pounds per cubic foot. Here we first find from (2) and (7)

$$f = 0.6 \qquad c = 71 \text{ pounds per square foot}$$

and formula (22) becomes

$$S = \frac{y}{108}\left[90\,y + 284 - 2\sqrt{193\,(90\,y + 142)}\right]$$

From this we find the following special values

For y = 10 feet	S = 27 square feet
For y = 20 feet	S = 159 square feet
For y = 30 feet	S = 421 square feet
For y = 40 feet	S = 809 square feet

These are the areas between the slope and the given ordinate and may be practically regarded as consisting of trapezoids, as shown in Fig. 6. The first area is that of the triangle $A\,b\,B$, hence

$$\tfrac{1}{2}.10.\ A\,b = 27, \qquad \text{or } A\,b = 5.4 \text{ feet}$$

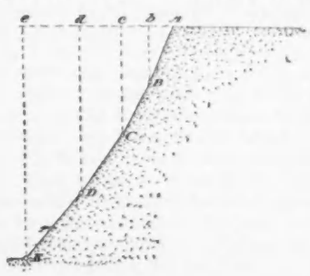


FIG. 6.

The second area comprises the triangle $A\,b\,B$ and the trapezoid $b\,B\,C\,c$, hence

$$27 + \frac{10 + 20}{2}.\,b\,c = 159, \qquad \text{or } b\,c = 8.8 \text{ feet}$$

The third area is that between $D\,d$ and the curve, hence

$$159 + \frac{20 + 30}{2}.\,c\,d = 421 \qquad \text{or } c\,d = 10.5 \text{ feet}$$

In a similar manner we find $d\,e$ = 11.1 feet and the four points B, C, D and E are thus located and the curve is now practically determined. In Fig. 6 the portions of the slope are drawn as straight lines; it may be so built or intermediate points of the curve be established by the eye.

It is not difficult to deduce from (22) the co-ordinate equation giving the relation between the abscissa and ordinate for every point of the curve, but it is of such a nature as to be of little practical use. In the manner just explained as many points upon the curve may be located as required. It is seen from (22) that S is negative for small values of y, or theoretically the curve overhangs the slope. Practically, of course, the equation should not be used for values of y less than H, and it will usually be found advisable and necessary that the upper part of the curve should be reversed in direction so as to form an ogee.

(TO BE CONTINUED)

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WE remarked last week that the official building examiners of this city, who permitted work of the Buddenseik class to be erected, must be either ignorant of their duties, or dishonest. The late investigation before the Coroner's jury shows that the first surmise was the correct one in this case. The examiner who was on duty when the Buddenseik buildings were commenced testified that he did not know what ingredients entered into the composition of mortar, and that he never mixed it or laid brick or stone work. From further evidence before this jury it seems that sand was used only to prevent the mud substituted for mortar from sticking to the hods. It seems that good mortar would have required about 250 loads of sand at these buildings, whereas three loads only were delivered, sufficient apparently for the purpose before mentioned. It is high time that builders of the Buddenseik type were made acquainted with the interior of a certain structure, which is honestly built and commonly known as a Penitentiary, as *Puck* suggests in a late cartoon.

THE Hall system of laying submarine pipes and tunnels is being brought to the attention of engineers in this country: it is said to have been already successfully used in laying a "double tunnel," 1230 feet long, across a portion of Sydney Harbor, Australia.

As described, the method includes, first the levelling of the river or harbor bed by dredging to a width required by the proposed structure. The chief feature of the invention is a caisson large enough to contain a section of the tube and provided at its front end with what looks like a plow-share. and connected with the open air by a vertical tube; this caisson is to be moved forward on the bottom by either hauling by power applied from above, or by pushing it by hydraulic jacks reacting against the finished portion of the work.

The connection to be made between this caisson and the shore tunnel is not plain in the description given, and the illustration shows only an exterior view. We are told that "the caisson is floated into position and anchored at the shore so that the tube projecting through the stuffing-box (in the end of the caisson) can be connected with the shore end of the tube or tunnel. Additional lengths of the tube are then sent down the air-shaft (in the roof of caisson) and put together by bolts through inside flanges."

We have little doubt that a system similar to the one thus roughly outlined could be applied to laying a submarine pipe, but before adopting it for a tube of the dimensions required by a railroad tunnel, for which it is proposed, we should want to see more about the actual working of the affair.

From what we know of dredged surfaces, the caisson would have rather a rough road to travel and a track that would vary widely in consistency of material. If the inventors *can* control the position, motion and direction of the caisson proper, the pipe sections can probably be connected, but even then they would want plenty of lee way in the bolt-holes, and a water tight lining to the iron cylinder. The promoters claim wonderful economy and speed of construction, and if they can make these claims good there is room for their machine in the rivers about New York.

THE Baltimore correspondent of *Bradstreets*, for April 18th., minutely describes the sanitary, or rather very unsanitary, condition of that city. With practically no sewers except a few used to carry off storm water, a surface drainage and a soil saturated with the accumulated filth of generations, Baltimore sadly needs the advent and active service of some skilled professor of modern sanitation. The city authorities have had sufficient enterprise to introduce one of the finest water supplies in the country, and wisdom enough to chain down the handles of the pumps that drain its polluted subsoil, and they should now advance to the further stages of proper drainage and decent paving.

THE account given elsewhere of the practical application of Telemetry opens up a wide range of possibilities. The use made of it by Mr. Herschel is especially interesting to the hydraulic engineer, as giving a positive and continuous record of the elevation of water in distant reservoirs and dams.

We personally know of several localities where this neat little instrument could be very economically substituted for the telephone or telegraph and the services of several trained assistants.

Its chief value lies in the shape of the record kept; on this little sheet an indelible marking pen is continually noting down the conditions; day and night, at all times and without intermission, rest or holiday. These records can finally be compared and studied for any period of time, and they furnish data of great value for the improvement or correction of existing methods or errors. It practically brings the steam boiler, the refrigerating room or the storage pond to the very desk of the observer, whether that desk is more or less distant from the thing to be observed. It but marks a further step forward towards the wonderful future of electrical science as applied to our every-day life. The end of that application no man can yet foretell.

London Water.

Sir Francis Bolton, C. E., is the Official Water Examiner, appointed under the Metropolis Water Act of 1871, to examine and report monthly upon the quality of the water supplied to London by the several Metropolitan water companies.

From his report of January, 1885, now before us, we make the following abstracts:—London is at present supplied with water from the river Thames and Lee, and from certain springs in the valleys of these rivers, supplemented from the Chadwell Springs and from 10 wells in the north of London and 10 wells in the south, all of these wells being down to the chalk formation. The proportion of water supplied from each locality is, from the river Thames and chalk springs in its valley, 50 parts of the whole; from the river Lee and springs in its valley, 40 parts; the remaining 10 parts are from the wells, 7 parts of these belonging to the wells in the south of London.

The Thames water, in January, is reported "good in quality;" the rainfall for the year 1884 is stated as being only 15.06 inches. An official analysis by Dr. Frankland accompanies the report; this analysis, expressed in parts per 100,000 and taken at various points, gives for the Thames and Lee water,—total solid matter, from 25.50 to 35.54; organic carbon, from .085 to .255; organic nitrogen, from .015 to .053; ammonia, 0; nitrogen, as nitrates and nitrites, from .181 to .341; total combined nitrogen, from .224 to .384; chlorine, from 1.7 to 2.2; total hardness, from 18.6 to 23.3. The "deep well" water had a temperature of 12° Cent. as against 2.8° to 4.4° of the river water; the well water also contained 41.36 parts of solid matter only .039 of organic carbon and .010 of organic nitrogen, but had a hardness of 29.3.

The tentative standard of filtration recognized as official is,—a rate which does not exceed 540 gallons per square yard of filter-bed in each 24 hours; 12 years experience has found this rate to be effectual, and the water companies keep within this limit.

All of the companies are now, more or less voluntarily, giving a constant supply in some portions of their districts. 980½ miles of streets now contain water mains.

The "Regulations" specify the following dimensions and thickness for lead pipe used for water:

Internal diameter of Pipe.		*Weight of Pipe.*
½-inch diameter	5	lbs. per lineal yard.
⅝ " "	6	" "
⅞ " "	7½	" "
¾ " "	9	" "
1 " "	12	" "
1¼ " "	16	" "

All pipes used in the interior of dwellings for water furnished by the companies and in contact with the ground must be of lead. Two feet six inches below the surface is given as the depth requisite to protect the pipes from freezing.

The detailed report of the eight Companies for January 1885 contains the following items: Average daily supply during the month, 144,641,771 gallons; number of supplies to houses returned, 685,693; number of houses on constant system, 287,778; estimated population supplied within the water districts, 5,087,770; Subsiding and storage reservoirs for unfiltered water, 54; area, 465¼ acres; available capacity 1,290,100,000 gallons; covered storage reservoirs for filtered water, 53, with 160,002,000 gallons capacity. Number of engines used, 150, with 17,215 horse-power. Number of miles of mains, 4,114; mains in the Metropolis, 2,968. Number of street hydrants 7,213.

The greatest lift by steam power is 380 feet, at the Lambeth works. The total number of filter beds is 97 with an area of 97¾ acres in total; the depth of sand and gravel in these beds ranges from 5 feet 6 inches to 8 feet and the maximum rate of filtration per square foot of area in gallons per hour is from 1½ to 2 gallons, at the several works; 55¾ acres of filter-beds were cleaned in the month of January, 1885.

Some Notes Concerning Jetties.

The annual report of the Chief of Engineers, of which we gave a notice last week contains detailed statements of the progress of a number of harbor improvements were jetties form the main feature of construction. The following is an abstract of the salient points of interest relating to some of these jetties.

Nantucket harbor, on the north side of the

island of the same name, has deep water and would form a good harbor of refuge were it not for the bar that obstructs its entrance. About 1830 the sum of $44,000 was spent in dredging, but no improvement resulted, In 1880 the construction of riprap stone jetties from the eastern and western sides of the entrance across the bar was begun, in order to cut away the bar by the force of the current. The jetty has been built a distance of 3,515 feet, while no work on the eastern one has been done. The amount expended to June 30, 1884, was $22,412, the sum available for the present fiscal year is $21,818, and the estimated amount required to complete the work is $128,000. The ruling depth of water in the channel over the bar is about six feet at low water.

At Port Jefferson harbor, Long Island, two stone jetties or 1,390 and 940 feet length have been constructed at a cost of $80,200. These serve to protect the harbor from the wash of the sea rather than to increase the velocity of the current. They are about 1000 feet apart and built in water six feet deep.

The mouth of Manasquan river, N. J., forms a harbor about 5 feet deep at low water, whose mouth is closed by a bar bearing a depth of water of only about a foot. In 1879 jetties were begun, one of which has been extended 1,515 feet and the other 475 feet, the outer end of the latter being 100 feet inside the former, and enclosing between them a channel 200 feet wide. The depth on the bar has been increased to about 3 feet, but by further extending the jetties this may be rendered greater. The amount expended was $39,000, and $33,000 additional is required to complete the work.

The improvement of the harber of Charleston, S. C., was begun in 1875 by the construction of two jetties, which are composed of riprap stone, resting on a broad foundation mattress of logs and brush. The jetties spring from Sullivans and Morris Island and converge towards each other on curves so as to cross the bar on parallel lines at a distance of about 29,000 feet apart. The available depth on the bar has heretofor been 11½ feet, but it is expected to increase the channel depth to 21 feet, The length of the north jetty on June 30, 1884, was 14,327 feet and that of the south jetty 14,-109 feet. The work during the past year was in water varying from 8½ to 13 feet. The width of the mattress is 108 feet. The effectiveness of the jetties has been impaired by the tardiness of Congress in making the necessary appropriation, but the bar has moved seaward several hundred feet, The amount spent has been about $1,395,000, while the sum available for the present fiscal year is $250,231, and the estimated cost of completion $600,000.

At the mouth of Saint Johns river, Florida, jetties are also in process of construction, the plan essentially consisting of a mattress foundation, or a platform of logs, on which rip rap stone is laid. The usual depth over the bar was about 6 feet, but it is expected to secure a channel of 15 feet. On June 30, last the completed length of the north jetty was 1,115 feet and that of the south jetty 4,813 feet. The total expenditures have been $372,-836, while the sum available for the present year is $152,000 and the amount estimated for the completion of the project $600,000. It is thought that some dredging may be required between the jetties to give direction to the currents.

The great jetties at the South Pass of the Mississippi have maintained the full depths and width of channels required by the law during the year embraced by the report. The recent discussion of the effects of these jetties by the American Society of Civil Engineers render it unnecessary for us to recapitulate the matter included in the report. The charts and tables presented by Mr. C. Donovan, assistant engineer in charge, show in full detail the changes and existing conditions.

The jetties at Sabine Pass, Texas, were begun in 1882, and the foundation course of the west jetty has been laid for a little over three miles in length, and 6,146 feet is practically completed. The scour upon the bar has not yet begun, nor is it expected that it will until the second jetty is in place. The construction consists of mattress foundation ballasted with rock. The total cost of the work will be about $3,000,000.

The improvement of Galveston harbor, Texas, created considerable discussion at the last session of Congress, and the report shows that the south jetty had been partially completed for a length of about five miles. The depth of water upon the inner bar has already increased one foot, and upon the shoal in Galveston channel where there was but 18½ feet in 1883, and but 17½ in 1882, a central depth of 21½ feet has been secured. The original estimate for the improvement was $1,826,000, of which $825,000 has been appropriated.

At the mouth of Brazos river, Texas, the north jetty has been completed for a length of 2,433 feet, while but little has been done on the south jetty. The works remain stable, and the depth of water upon the bar has been kept quite constant at about 8 feet. The estimate for the construction was $522,890, of which $140,000 has been appropriated.

A number of other jetty constructions are included in the report, but it is thought those mentioned are the most important. It now seems to be thoroughly established that the dredging of a bar at the mouth of a river affords only temporary relief, and that the cheapest and most effective means of removing it is by the construction of jetties which increase the velocity of the current and cause the bar to be cut away. This material is deposited in deep water beyond, and it is to be expected that a new bar will be formed, but the laws of that formation have not yet been established.

A CORRESPONDENT has been taking unwarrented liberties with our front page announcement, of April 11, of Trautwine's New Edition, by mixing it up with cuttings from a circus poster apparently. While the compound is rather rough upon our well intentioned purpose of advertising, for the benefit of our readers—and ourselves,—the "revised edition" makes odd reading and we give it as follows:—

"The Greatest Show on Earth. Over 2000 tons of unique object-teaching and benign entertainment. Trautwine's Civil Engineers Pocket-Book. The Ten-acre Tented Capital of Wonderland. With $500,000 worth of New, Startling, Instructive, Exclusive and most Signal Wonders, added to a full $4,000,000 worth of Moral and Magnificent Amusment. In Engineering, a Library. An Encyclopedia. Unapproachable in Excellence. Indispensible to every Civil Engineer. A book of World-wide fame. The Work of a Busy Lifetime. The Mightiest and most marvelous Assemblage. Send in your orders. Price $5.00. It's price is as low as that charged by Unrecognized and Petty Shows, and it not only deserves your patronage but it will pay you twenty-fold to wait for it."

A REMARKABLE RIVER.—Endeavors were recently made to explore the remarkable river Reka, which rises in the Austrian province of Carniola and disappears in a series of caves known as the Karst Caverns At a spot some 20 miles distant a stream called the Timavo flows out of a hillside, and there is reason to believe that this is identical with the Reka, which thus flows twenty miles underground. The party engaged in the recent explorations followed the subterranean course of the Reka about one furlong, and passed six waterfalls, until they reached a seventh fall, which it was impossible to get over without the construction of special apparatus, as the river has no banks at that point. The explorers employed the magnesium light to illuminate the dark course of the stream. One of the caverns through which it runs is large enough and lofty enough to hold St. Peters Cathedral at Rome.

PERSONAL.

MR. ANDREW RINKER, was re-elected City Engineer of St. Paul, Minn. on April 14th.

COL. ROBERT FORSYTHE, Traffic Manager of the Chicago and Eastern Illinois Railroad, died at Savannah Ga., April 15th.

OSCAR H. PEACOCK of Rochester, N. Y., has resigned the office of City Surveyor, after serving a term of nine years.

WILLIAM JACKSON, late connected with the Boston Improved Sewerage, was elected City Engineer of Boston on April 15th, to succeed Henry M. Wightman, deceased.

ANDREW MURTS, a well known bridge builder of Chatanooga, Tenn., was killed last week by falling from a high trestle on the Vicksburg & Meridian R. R.

J. W. JOHNSON, of Portland, has been appointed engineer of the Northern Pacific Terminal Company at Portland, to succeed F. W. Gilbert, appointed superintendent of the Rocky Mountain division of the Northern Pacific.

JACOB GEIGER, aged 75 years, a prominent citizen, died at Hamburg, Pa., on April 15th. He was a well-known contractor on the Reading Railroad and Schuylkill Canal at the time of their construction.

C. E. HEALY, who built many of the bridges on the North Pacific R. R., fell from the bridge now under construction at Mount Gulch, Mon., on April 3d; he was killed instantly the height of the bridge being 226 feet.

W. A. SCOTT has been appointed assistant superintendent of motive power and machinery for the Northwestern. For the past eight years he has been master mechanic at the Winona & St. Peter's shops, at Winona. William Smith, general foreman of the North Chicago shops, will succeed MR. SCOTT at Winona.

J. B. CABLE, Superintendent Rocky Mountain Division Northern Pacific R. R., has resigned, to take effect the 15th inst. He has received an appointment as General Superintendent of the Wisconsin Central R. R. F. W. Gilbert, formerly an engineer on the N. P. R. R. under General Anderson, is to succeed MR. CABLE.

H. M. KERSEY, who was recently in the service of the Northern Pacific at St. Paul, and subsequently visited China and Japan in the interests of that company, has received a commission from the English government to join the survey from Suakim to Berber in Egypt. He will also be identified with the construction company which has the contract for building the road. Mr. Kersey has already sailed from London, bound for the Red Sea.

Boston Society of Civil Engineers.

On the afternoon of Wednesday April 15th, about twenty members of the Boston Society of Civil Engineers visited the Labratories of Mechanical Engineering, Applied Mechanics and Mining at the Massachusetts Institute of Technology, and the shops used in connection with the Institute and the School of Mechanic Arts. The practical operation of a machine used for testing the transverse strength of beams was shown by breaking a 4″ × 12″ oak beam 19 feet in length. Other apparatus used in testing engines, and boilers, the slip of belting etc., in the mechanical labratory, and in the reduction of ores in the mining labratory were shown by Professor Lange and Richards. At the school of Mechanic Arts was shown the work done by the students in the carpenters and model department, iron and brass moulding, forging, chipping, filing and lathe work.

In the evening a regular meeting of the society was held, 27 members present.

W. Wendell Wright, H. D. Woods and W. A. Allen were elected members of the society.

A committee was appointed to prepare a memorial of the late H. M. Wightman.

Papers were presented by P. D. Borden, Jr., and Prof. W. Ripley Nichols on the Corrosion of a cast-iron water pipe from the Fall River Water-works. Mr. Borden's paper gave a description of the location and other circumstances under which the corrosion occurred, and Prof. Nichols gave the results of a chemical examination of the corroded pipe. E. W. Bowditch read a paper on Sanitary work at the University of Virginia.

Connecticut Engineers' and Surveyors' Association.

The meeting was called to order at 10 A. M., April 15th, at Grand Army Hall, Waterbury by President B. H. Hull. After a short address of welcome by the president of the association, the regular order of business was taken up.

Twenty-seven members of the association were present.

Mr. R. D. Barnes, of Bristol, read a paper on the proposed plan of the Bristol Water-Works, with a complete set of maps and plans.

Mr. Barnes was followed by Mr. N. J. Welter, of Waterbury, on the Waterbury Water-Works, of which Mr. Welter has been the engineer since the works were commenced, some ten years ago. With his paper he had a full set of maps and plans, and a large number of photographs of works in progress and completed. After the reading of Mr. Welter's paper, Mr. C. M. Jarvis, Chief Engineer of the Berlin Bridge Co., provided carriages and invited all present to visit several bridges around Waterbury, built by his company. The trip was accepted of and several large bridges were visited, and Mr. Jarvis was very busy in explaining the method of constructing bridges, etc. At 1 P. M. the association, in behalf of the members of Waterbury, took dinner at the Scoville House; at 2.30 P. M. the association took a special train tendered by the N. Y. & N. E. R. R., and went to Hop Brook to see the 93 foot in height, trestle bridge; at 4 P. M. the association was shown the working of the new apparatus for cleaning sewers, invented by the City Engineer, Mr. Weld, also several new plans of manholes and catch basins, and method of flushing the same by a watering cart. At 4.45 P. M. the association met at the hall and had read to it a paper on the Development of Drainage Areas for Water Supply of Cities and Towns, by Henry W. Avers, of Hartford, Conn., Engineer of the Hartford Water-Works.

The next meeting of the association will be held at Middletown, Conn., about the 1st of Sept., and will inspect the large quarries and the works of the Berlin Bridge Co., also visit the renowned Lyme Viaduct.

D. C. SANFORD, *Secretary.*

COPELAND & BACON, of this city, have sent us their new catalogue of hoisting engines and mining machinery. It is profusely and well illustrated with photo-engravings showing the style of the many types of hoisting engines and contracting and mining machinery made by this old and favorably known firm; it has full price lists of machinery, wire rope etc. Among the new illustrations is a cross-section of a 100-ton Concentrating Works, designed and erected by this firm at Brewsters, N. Y.

THE WEALTH OF THE COUNTRY.—In 1860 the wealth of the United States was equivalent to $615 per capita; in 1880 it was $940 per capita. In New England the wealth to each person was $610 in 1860, and $1,235 in 1880. In the Middle States it was $525 per capita in 1860 and $1,430 in 1880. In the Southern States the rate per capita in 1860 was $595 and $299 in 1880. This falling off is due to the emancipation of the slaves and the losses by the war. In the Western States the rate per capita in 1860 was $450 and in 1880 $850. Exclusive of roads and public lands, the per capita wealth of the whole country was $535 in 1860 and $830 in 1880.

Telemetry Practically Applied.

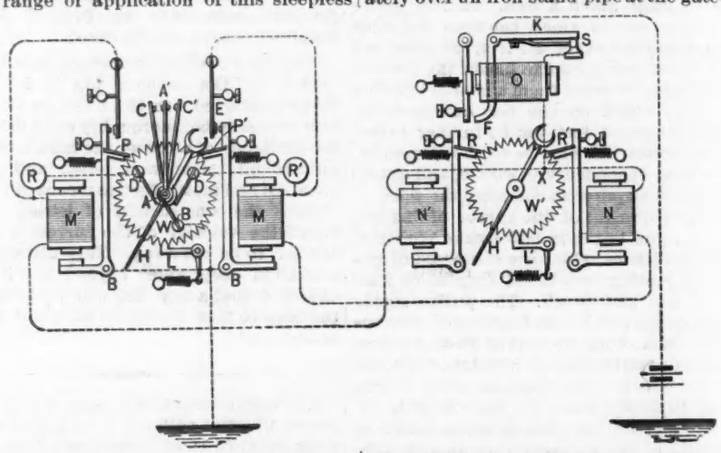
Telemetry is a term applied to the late application of electrical science to the indication and automatic record of variable physical forces, and the transmission of this record to any reasonable distance. The value of a positive and continuous record of this character, transferred from any point of application to the very office of the user, is too apparent to need further remark.

Mr. Robert Hewitt, Jr., who must be considered as the originator of the first practical application of the electric current to this useful purpose, had his attention turned in this direction in the summer of 1882, while connected with the refrigerating machinery now manufactured by the Continental Works of Mr. T. F. Rowland. He there recognized the importance of having temperature indicated and recorded at a distance and made his first experiments. This was followed by the association with him in the enterprise of Mr. Chas. L. Clarke, the Chief Engineer of the Edison Electric Light Co., and the details of the apparatus were worked out and perfected by this expert in electrical science.

The range of application of this sleepless and faithful watchman can not yet be fixed. For nearly a year it has been recording and indicating to the engineer in the basement the fluctuations of level in the water-tank on the roof of buildings where hydraulic elevators are being used; and in peforming this duty the Indicator records 30,000 electrical impulses weekly. It has been applied very successful to recording steam pressure, and the record shows, written in indelible ink, the variations of pressure within 2 lbs., and the marking is so positive in its nature that the shutting-off of steam is indicated on the diagram by a firm, straight line.

It has in fact passed beyond the stage of experiment, and a better idea of its usefulness can perhaps be formed by stating a few points of actual application. As an indicator of temperature, for which use it was originally invented, U. S. Fish Commissioner, E. G. Blackford applied it last November to his freezers, situated in a street at some distance from his office in Fulton Market in this city. He says of it that, "I am now entirely free from any apprehension of carelessness or inattention on the part of my employees in keeping the freezers at the required temperature. I look upon the tele-thermometer now as an indespensible adjunct to my business plant, and next to the telephone in usefulness and value." In one of our leading hospitals an instrument in the contagion ward indicates in the physician's consulting room, 800 feet distant, every degree of fluctuation of temperature, and enables the conditions of treatment to be studied in a manner never before possible to medical science. At the Houghton Farm, near West Point, several instruments are used in determining the temperature of the soil, etc., and the record is invaluable in a proper study of agricultural engineering. At the 42nd St. Presbyterian Church, in this city, where a very elaborate and expensive heating plant has lately been put into service, there are four of these instrument in use; and they show the sexton in charge the exact conditions of temperature in the various portions of the building, at a central point, and enable him to regulate it accordingly. And a later, but in its way, an important service, was in the careful control of the temperature in the refrigerated room used for storing the vast amount of prepared food furnished by the New Murray Hill Hotel for the late Inaugeration Ball.

But its very latest and perhaps one of the most interesting applications of Telemetry is to the recording height of water in the storage dam of the Holyoke, Mass. Water Power Co. Mr. Clemens Herschel, the Consulting Engineer of the Company, had been examining into the possibilities of this instrument for some time, and to meet his requirements Mr. Clarke lately constructed a special apparatus, known as a Tele-hydro-barometer. In this case the Indicator is placed immediately over an iron stand-pipe at the gate-house of the dam, and is connected to a large copper float resting on the surface of still water within this pipe. The recording dial is in Mr. Herschel's private office nearly one mile away, and there, on a circular record sheet 12 inches in diameter, is indicated and indelibly marked all fluctuations of water-level up to 20 feet and by units of one-twentieth of a foot. Each sheet contains a record for one week and Mr. Herschel has expressed his entire satisfaction with the working of the instrument and wishes all interested parties to be referred to him.



The two instruments, the transmitter and the receiver and recorder, are shown in the accompanying illustrations. Without entering into a detailed description, we can only say that Mr. Clarke has here solved a most difficult electrical problem, i. e., the maintenance of a perfect unison or automatic synchronism between the two instruments. They are operated on the open circuit principle involving a minimum expenditure of battery power.

In the above cut, the transmitting device is on the left hand and the other is the receiver. The central shaft A, which carries the contact-arm A', also carries the index arm of the thermometer, steam gauge or other indicator of pressure or motion; the movement of the index arm of the thing to be observed being transferred to this shaft A by mechanical devices already well known. In the transmitter, B is the ground connection; C and C' are two contact points carried on arms each side of A', they revolve on an insolated sleeve and are insolated from each other; D and D' are two insolated posts, which carry two wires resting each in a groove in the insolated sleeve, and these preserve the continuity of the circuit as the wheel W revolves with the arms C, C'; H is

an index hand carried by the same shaft as that on which W and C, C' revolve. P and P' are the pawls which propel the wheel W, and are normally out of the path of this wheel which is held by the locking pawl L. The actual working of the two instruments would involve a description too long for the purpose of this notice, and those personally interested are referred to a detailed description given in the *Electrician* of December, 1884.

The device here indicated has been secured by letters patent by the inventors, in this country and abroad; and the instrument is now entered for the prize offered by the *Société d' Encouragement pour l' Industrie*, of Paris, which has offered a premium for a practical machine which would give the varying temperature of heated room or ovens. The Mass. Charitable Mechanics Association, at its last exhibition, awarded Messrs. Hewitt & Clarke its diploma and silver medal. For any further detail of the application of this useful invention, we must refer parties to the gentlemen named at their office in the Washington Building, New York.

CORRESPONDENCE.

What is "Best American Wrought Plate Iron?"

ROCHESTER, N. Y., April 4, 1885.

EDITOR ENGINEERING NEWS.—In a printed specification for a tile sewer and a sewer outlet there is found a requirement for a certain amount of wrought-iron pipe 27 inches in diameter and ¼ inch thick. The quality of the iron for the latter is specified as follows:

"The iron plate * * * * shall be manufactured from the best American wrought plate iron * * * *." No other qualification is mentioned. Under this specification bids for a definite *quantity* were received. The highest bid was nearly 90 per cent. above the lowest, showing a wide difference of opinion as to the *quality* to be furnished.

Question! What does the above qualification mean? what grade or trade mark of iron does it call for?

"PLATE IRON."

[In answer to the above, we would say that the wide range of bids is what should have been expected from the obscure wording of the specification, which is practically no specification at all. The man who wrote it intimated that he wanted the best wrought plate made in America; the bidders proposed to furnish what they in their individual judgment thought good enough for the purpose intended. No special trade mark is called for, and as to grade "best refined iron" would perhaps convey a better idea, but even then the samples submitted must decide which is the best.

ED. ENG. NEWS.]

Freezing of Water Mains

537, GREENWICH STREET, NEW YORK, April 8, 1885.

EDITOR ENGINEERING NEWS.—In reference to request for information in your issue of March 21st, on freezing of water pipes, a few words in addition to what you have published in your last issue from Prof. Landreth may explain why freezing occurs just after a heavy thaw in early spring, rather than during the prolonged cold of the winter months.

It is a well known fact that porous soils are better conductors of heat in proportion as they approach complete saturation with water. As long as the ground is frozen solid and hard, the surface stratum acts as a waterproof covering to the lower strata or portions around the water pipes, enabling them to retain their porosity and consequent low conductivity. As soon as the surface stratum is during the first warm spell sufficiently thawed out even for a short time, not only do the strata around the pipes become better conductors, through the accession of their compliment of water, but their temperature is also reduced by the low temperature of the water passing into them, which is at 32° F, or a little lower. The advocates of the "ice cream freezer" theory would claim that it is considerably lower than 32° F. though this may be doubted. At any rate the temperature of the earth around the pipes is reduced so low by the infiltration or *circulation* of water at 32° F. or lower (?) around them, that it requires but little further loss of heat by *conduction* to freeze the water in the pipes, and this decrease of temperature is undoubtedly facilitated by the better conductivity of the water-soaked soil.

Where the infiltration of water at 32° F. or less (?) could be prevented, in some places at little extra cost, by the use of puddled clay or other impervious materials in refilling the lower portion of the trench, there is no doubt that a large portion of the trouble due to frozen water pipes could be prevented.

Very respectfully, etc.

GEO. RIEDEMANN.

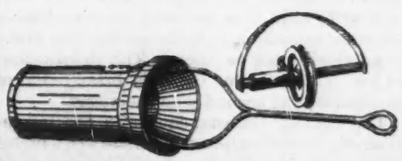
[We have on our hands a number of other communications explaining the "Pipe-freezing problem," but as the ground has been pretty well covered by the letters already published we must call a halt. Ed. ENG. NEWS.]

Sewer Cleaning.

OFFICE OF CITY ENGINEER.
WATERBURY, CONN., April 4, 1885.

EDITOR ENGINEERING NEWS:—We have in this city about 10,000 feet of small brick sewers, 1' 6" × 2' 3" and 1' 8" × 2' 6" in diameter. These sewers carry storm-water from catch basins, and some of them having light grades are found to retain a deposit of sand or mud after a violent shower falling upon dry unpaved streets. This sand is carried over from the basins by the rush of water during a storm and has to be removed. The sewers are too small to admit of its being removed easily and economically by men working inside, and flushing by water fails to start it readily, so we have devised an apparatus which has been proved very convenient and efficient for cleaning small brick and large pipe sewers. It may be suited to the wants of some one else, therefore, with your permission, I will describe it.

It consists of a three legged derrick, a scraping bucket, and a pulley set in a frame. The derrick stands about 8 feet high, has attached to it two legs a drum for rope to coil upon, and in place of cranks has two ordinary carriage wheels. The bucket or scraper is made of galvanized iron strengthened by iron bands around the mouth and at the other end. It is 8 inches in diameter, about 2 feet long and has a flaring mouth. To the inside of the mouth is fastened an iron bail, and at the opposite end is a ring. The pulley which is 6 inches in diameter, runs on an iron shaft 1½ inches in diameter. The two ends of this shaft are joined by a band of iron ¾ inch by 2 inches, bent to conform to the arch of the sewer inside. A turnbuckle on the shaft serves to lengthen it, and presses the ends against the walls of the sewer to hold the whole in place. The manner of working is this: The pulley and frame are set in position in the top of the sewer, at a manhole where the material is to be raised and the derrick is set up over the manhole.



A small line is floated down from the next above, and when found at lower manhole is used to draw through a rope, one end of which is made fast to the bail of the scraper, and the other end to the drum on the derrick. A rope is also tied to the ring on the scraper, and is payed out as fast as the scraper goes forward, and is used to pull it back again for a fresh load when empty. The rope which is fastened to the bail of the scraper passes from the upper manhole to the lower one, under the pulley, and up to the drum on the derrick. The wheels are used as cranks, the scraper is drawn down from manhole above, brings its load of sand, passes under the pulley, and is raised to the surface and dumped. The empty bucket is lowered, and is pulled back the whole distance or part way as the quantity of deposit may require. It is not necessary to touch the bucket, or disturb the load it carries at all until ready to be dumped on top at the end of each trip. Repeated trips leave the sewer perfectly clean between the two manholes, then the third leg of the derrick is folded down on the others, the bucket, pulley, and ropes are loaded on the derrick and the whole is trundled off to another place on the wheels, which have done duty as cranks. The whole apparatus is not expensive and it has done good service here. We can use it as well in pipe sewers as in brick, and have had no difficulty in working around curves. I purpose to leave wires between some manholes where there is likely to be any trouble in floating down the first line.

For cleaning our small pipe sewers we use a large "monitor" watering cart as a portable flush tank.

F. FLOYD WELD, *City Engineer.*

Philadelphia Water Department Surveys.

PHILADELPHIA, PA., April 7, 1885

EDITOR ENGINEERING NEWS:—The correspondent who signs himself "Topographer" in the last issue of your paper, is apparently under the impression that the survey in progress under direction of the Philadelphia Water Department has been made with a range finder, barometer, Abney level and azimuth compass. As a matter of fact the first two instruments were rarely used at all, while the latter were used only in "filling in" between established circuits, for which purpose they were found to be admirably adapted. The main circuits were ordinarily a couple of miles or so in length, but these were again divided by stadia lines into areas depending in size on the ground, but averaging perhaps ¼ square miles, in such a way that all the ground could be reached.

The writer is at fault in his statement that this was referred to as the most extensive topographical survey that has been undertaken in this country. To be more explicit, it is, *so far as I am aware*, the most extensive one that has been made with equal accuracy and detail. To compare it with the Geological Survey of New Jersey is hardly fair, from the fact that a gross error on a scale of 400 feet to the inch would be imperceptible on a scale of 1 *mile* to the inch, which I understand is the scale adopted for the latter.

KENNETH ALLEN.

P. S. The explanation given March 28th for the freezing of water mains in early spring, seems to be based upon a misconception of the nature of heat, and I think a comparison with the action in an ice-cream freezer is not valid. In this case the salt lowers the melting point of the ice. In melting at 27° (for instance) heat is absorbed and the temperature of the surrounding mass is lowered about 5°. This reduction is sufficient to freeze the water in the cream. Now, if in place of salt, the sun's rays were directed upon the freezer till the ice had disappeared, does anyone suppose a particle of the cream would be frozen thereby?

In the ground, on the contrary, the melting point remains at 32° and a certain amount of heat is absorbed in melting from external sources. I believe it is a well established fact that heat is always transmitted in excess from the warmer body to the cooler—that otherwise we should hold the key to perpetual motion. Now, as the ground below is *cooler* in this case, and the air warmer, the excess of heat flows from the air through the earth *downward*.

I think some other explanation is necessary to account for the facts, that of Mr. Landreth, given on page 218, being more plausible. K. A.

Relief Maps.

DOWNEY, PA., April 20, 1885.

EDITOR ENGINEERING NEWS.—In the current number of the *Nation*, page 323, there is a short notice of the discovery of a method by which plane-surface maps are reproduced with the curves and altitudes in relief, so represented as to correspond absolutely with the elevations established by accurate observations.

These maps cost no more than ordinary flat maps are drawn on moderately thin paper, can be rolled and are not injured by water.

The process is said to be partly mechanical, partly chemical.

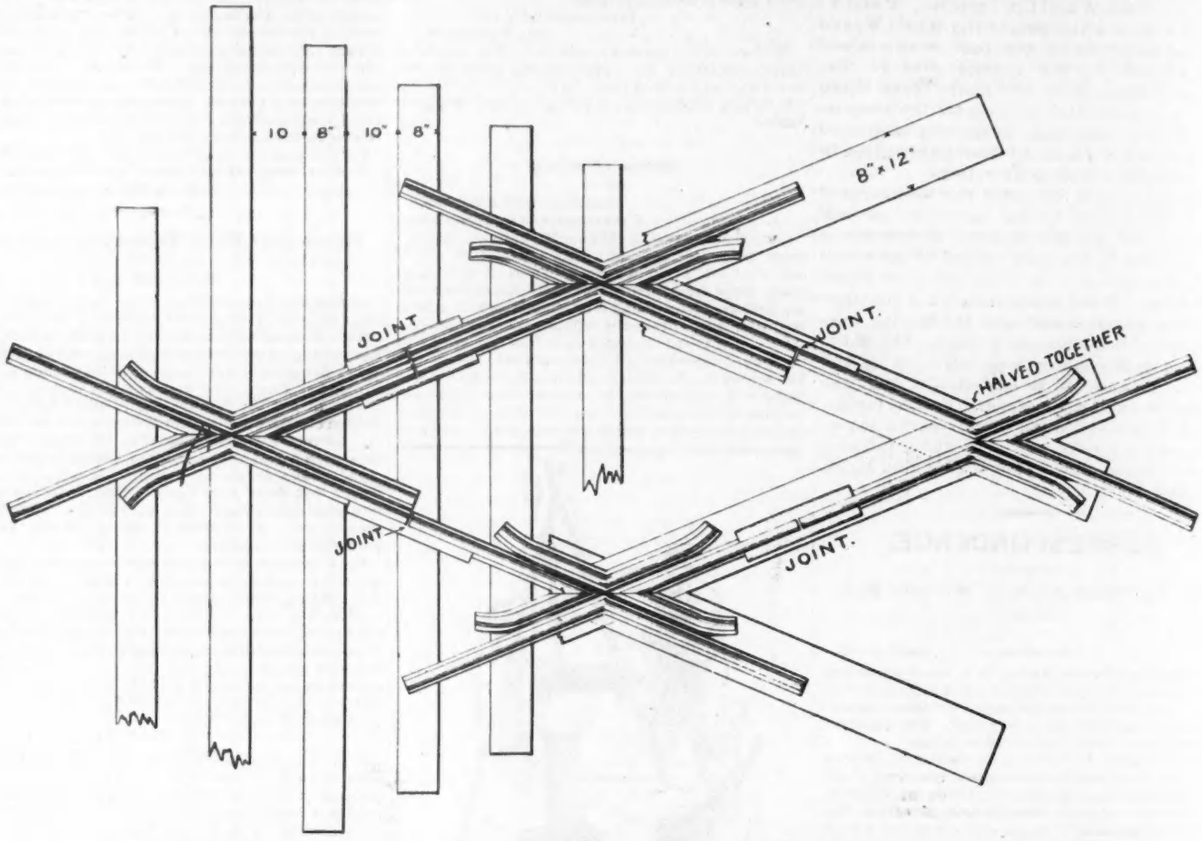
The Paris correspondent of the London *Times* says the whole topography of a country can be seen on such a map at a glance.

Can you give us some more detailed account of the process? C. E. W.

[We publish the question of "C. E. W." in the hope that some of our readers can give the information required.—ED. ENG. NEWS.]

CAST-IRON COLUMNS AS MAIN SUPPORTS.—The employment of cast-iron columns as main supports has been greatly restricted at Berlin by a regulation issued from the architects' department of the police authorities of that city. The order has been issued in consequence of a discovery made last winter at a fire, when it was found that the cast-iron columns had been cracked by the effect of the cold water playing on them while hot. The authorities now insist that where partition walls rest upon cast-iron columns the latter are to be covered with plaster or bricked in, with an air space between the bricks and the column.

FIG. 80.—CROSSING FROG; SHOWING TWO METHODS OF CONSTRUCTION, AND TWO STYLES OF SUPPORT.



TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(Continued from page 252).

Crossing frogs are used when two tracks cross each other instead of as heretofore when one track branches out from another. In a crossing there are four frogs to each track, of which two are "single pointed," that is, similar to turnout frogs, and two are "double pointed" as shown in the general diagram of a crossing, Fig. 80.

The general construction of crossing frogs is similar to that of the frogs already described; the angles usually determining the details. They are made keyed, bolted, or plate according to preference although the first named pattern can only be used when the angle is small. Fig. 80 also indicates two styles of guard rails. When the angle of the crossing is large, say over 45°, it is common practice to have an inner rail running all around the crossing to serve as a guard rail and to give extra stiffness, separated from the main rail by fillers of cast or wrought-iron, if bolts are used. Such an arrangement is shown in the upper half of the diagram. As the angle becomes less, in order to economise rail, small guard rails are attached to each of the double pointed frogs as indicated in the lower half of the plan. It was previously recommended to dove-tail the rail forming the tongue, but with crossing frogs as the angle increases it is more satisfactory to unite them and finally to butt one against the side of the other. Some manufacturers make the whole crossing solid, that is, no joints in the sides between the frogs. While such a design adds stiffness it necessitated the taking up of the whole set in case one frog needs repairing. It is decidedly better to have one joint in each side so that the frogs are independent of each other. As the angle approaches 90° the wear of the frogs and the jolt received increases, because at great angles the wheel drops into the flange space of the other road since the tread fails to bear on the tongue and wing rail at the same time.

On account of this increased hammering received from two directions the life of a crossing frog is much less than that of a turnout frog. When one of the roads is double tracked it is difficult to keep the frogs in line owing to the running or creeping of the rails on the double line in opposite directions. In case both roads are double tracked this disarranging tendency and effect is mutual. There are two systems of support, either by long ties, or by sills, that is heavy timbers framed together according to the angle and the crossing spiked down on them. The determining of which is the better depends principally on the ballast and secondly on the angle

The heavier timbers, deeper in the ground than the cross ties (provided these are 6 inches thick), are less easily affected by the frost. For this reason if the ballast is poor it is better to use long ties but if good, so that there is no heaving, the framed timbers are preferable as affording better support and greater lateral stiffness to resist the tendency to go out of line. With single track, when the angle is less than 45° or closely approaching 90°, it is very convenient to use long ties as being more easily tamped and replaced and, with very small and great angles, giving good satisfaction.

In the former case place them so that they are symmetrical with both tracks that is perpendicular with the line bisecting the angle; while in the latter case place them in regular line of the track with principal traffic. With double track it is decidedly better to use the framed sets. Fig. 80 shows both systems of support. In all cases especially where the sills are used there should be a generous depth of good ballast underneath, not only the crossing itself, but also under both tracks adjacent to it.

(TO BE CONTINUED.)

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LITERATURE.

Transactions and Proceedings, American Society of Civil Engineers. January, 1885.

Contents:—*Experiments on the Flow of Water in a 48-inch Pipe*, by F. P. Stearns; and discussion by R. Herring, S. H. Yonge, E. B. Dorsey, W. R. Hutton and F. P. Stearns. *Commercial Cities*, by Alfred F. Sears; and discussions by John Bogart, G. S. Morrison and A. F. Sears. The Proceedings contain the reports of the Annual Meeting of Jan. 21st, the Com. on Common Standard Time, the Board of Direction, the Treasurer, etc.

The Windmill a Prime Mover, a treatise by ALFRED R. WOLFF, M. E. John Wiley & Sons, Publishers, New York, 1885.

The above work is intended to embrace everything of value relating to windmills, including their history development in Europe and America, pressure of wind theory of impulse and mathematical investigation. The book is expected to be a standard authority on this subject. It will be published within two months; subscription price is now $3,00, after publication it will be sold for $3.50.

How to Drain a House. Practical Information for Householders. By GEO. E. WARING, JR. M. Inst. C. E., Consulting Engineer for Sanitary Drainage. Henry Holt & Co. Publishers, New York. 1885. Price $1.25.

This is a hand-book for the people written in the pleasing style of Mr. Waring, and expressed in a form shorn of technicalities so that the layman may thoroughly understand. But the author especially addresses himself to the too limited class who are willing to learn and willing to practically apply the suggestions here thrown out. The subject matter relates to all the interior sanitary details of a modern house, and each of these is taken up in succession and dealt with according to the experience and personal belief of this sanitary expert. Throughout the work the *woman of the house* is held responsible for the close and careful supervision of the plumbing her husband has roundly paid for; and not the servants, but she herself, must see to it that no point is neglected or beginning of filth permitted.

Proceedings of the Engineers' Club of Philadelphia. No 3. Vol. IV.

Contents:—Annual Address of Col. Wm. Ludlow, Retiring President; Opening Address of Joseph J. de Kinder, President; An Improvement on the Ege-Walter Protractor, by A. E. Lehman; The Kaolin Beds of Chester Co. Pa., and of Newcastle, Del., by Graham Spencer; On the Adaptation of Movable Dams to the Ohio and other rivers of the U. S., as practiced by the

U. S. Corps of Engineers, by Prof. Lewis M. Haupt; Historical Sketch of the Work of the U. S. in the Improvement of the Ohio River, by Col. Wm. E. Merrill; English Centrifugal Pumps, by E. I. H. Howell; The Future of Locomotive Building, by Geo. S. Strong; The Navigation of the Air, by Russell Thayer; Measuring Chimney Draft, by H. W. Spangler; Enlargement of the East Mahanoy Tunnel, E. M. R. R. Schuylkill Co. Pa., by P. A. Taylor.

Steam Using; or Steam Engine Practice. By CHAS. A. SMITH, C. E., Professor of Civil and Mechanical Engineering at Washington University, St. Louis, M. Am. Soc. C. E. etc. The American Engineer, Publisher; Chicago, 1885. Price, $3.00.

This is a companion volume to "Steam Making, already noticed in this journal. The author has divided the subject matter of the present work under the following heads:—

The Nature of Heat and the Properties of Steam; Valve Gear; The Quantity of Steam which might be, and is used; On the Indicator, the Indicator Diagram and the different classes of engines; The Experiments of Hirn and Hollauer, and Steam Heating. Under each of these specific headings the material is handled in the concise and careful manner characteristic of Prof. Smith in all his work. The book is profusely and handsomely illustrated and its contents must find a hearty welcome among those to whom it is addressed.

Twenty Years with the Indicator. By THOMAS PRAY, JR., C. E., M. E., etc. Vol. II. John Wiley & Sons, New York, 1885. Price $2.00.

Volume I was issued in 1883, and a new edition has just been published; it consists of elementary instructions and explanations of the causes producing various indicator diagrams. Its price is $1.50.

The present volume, uniform in size, binding, etc., with Vol. I. give twenty years experience of a practical engineer in the re-adiustment and correction of the Steam Engine by the Indicator, for power, economy, etc. It is intended as a practical hand-book for the working engineer; and the directions, explanations and theories are given by the author without the use of a single mathematical formula. The diagrams are accurately engraved from original cards so as to represent as faithfully as possible the conditions commented upon. The range of experiments is a very wide one. The work is handsomely published, and the editorial experience of the author shows itself in the plain, concise, but very readable manner in which he has presented his subject.

Removing Rock by a Diving Bell.

Le Genie Civil, of April 4th, describes an apparatus for removing submarine rock from harbors, etc., by means of a species of floating, pneumatic caisson or huge diving-bell.

The machine described is the invention of M. Hersent, and was successfully applied in the harbor of Brest. This diving-bell is made up of five distinct parts: 1st, a caisson or working-chamber; 2nd, an air-chamber surmounting it to give buoyancy; 3rd, a large central shaft, with air-locks at its base; 4th, four smaller shafts for removing the debris; 5th, a platform on the upper part above the water-level.

The working-chamber is sufficiently large to accommodate 20 or 25 men. It is about 33 feet long, 26½ feet wide and 7 feet in clear height; and is without a bottom. The iron sides of this caisson are from 8 to 9 *millimeters* thick, and the roof is solidly reinforced by iron beams 29 inches deep; the bottom of the caisson is furnished with a cutting edge of iron, about ten inches deep by one inch thick. The sides of the chamber are securely connected with the roof by bracing.

The air, or balancing chamber, is immediately over the working chamber and has the same horizontal dimensions, with a height of about 14 feet. As this chamber is filled with air or water the bell floats or sinks. The sides of the chamber have a double-skin wall braced. The space between the beams at the roof of the working chamber is filled with beton to insure stability.

The central shaft is 10 feet in diameter, and is supplied with a winding, iron stairway, and has two air-locks at the bottom; the lighting of the working-chamber is done by electricity. The four shafts for removing material are arranged around the central shaft and some distance from it; they are made of steel, and each is about 18 inches in diameter. The interior of these tubes is smooth, and in them move pistons of metal with rubber packing; upon these diaphragms are placed the buckets containing the debris, which are lifted to the top by the action of compressed air.

The platform at the top is about 18×16 feet, and is surrounded by a light hand-rail. The other parts of the apparatus consists of a 4 inch pipe for conveying compressed air to the working-chamber; two bronze pumps for emptying the balancing chamber; a 2¾ inch sand-pump pipe for removing material in a liquid form, and finally a safety valve in the roof of the balancing-chamber and so arranged as to prevent any accumulation of air in this chamber while the apparatus is at work; otherwise the bell might be lifted and occasion accident.

In operating the machine, it is brought over the proper site and then sunk by allowing water to flow into the upper chamber; compressed air is then permitted to enter the working chamber and the water expelled from it; 15 to 20 minutes is the usual time for this operation.

The bell rests upon the more prominent point of the rock and some blocking may be required if the rock surface is very irregular; bags of clay are packed into the lower portions to make a dam, and the material is removed usually in beds of about 3 feet in thickness with one placing of the caisson. Blasting is resorted to when necessary with perfect safety.

The stability of the bell is assured by ballast placed back of the braces and between the roof beams of the working chamber. When floating, the actual weight of the bell, including ballast, is about 726,000 pounds; the displacement of the balancing chamber and of the ballast, the working chamber being full of water, is 990,000 pounds. As a result the line of flotation of the apparatus is about 5 feet below the roof of the balancing chamber.

When the apparatus is submerged, the displacement of the working chamber and the ballast, and also the lock and shafts for about 40 feet in height, is 686,400 pounds. As a consequence the load on the cutting edge, when at work, is about 39,600 pounds. If we suppose a total load of 726,000 pounds, on this cutting-edge, a possible condition with the bell almost entirely out of the water, and this load supported by only about 6½ feet in length of the sides, an extreme case, the load per square inch of this edge would be 8,533 pounds.

The price at which M. Hersent contracted to remove the numerous rocks in the port of Brest, using this machine, was 62 francs 50c. per cubic metre of rock actually taken up; this is about $9. per cubic yard.

"WHITE BRONZE"—A NEW ALLOY.—According to the *Polytechnische Notizblatt*, experiments are being made in Paris with a new alloy, of a white color, which has been named "white bronze." It is made of copper and and ferro-manganese, the proportion being varied accordingly to the purpose for which the alloy is to be employed. Forty parts of copper and sixty parts ferro-manganese, with a suitable quantity of some appropriate flux, produce a metal of such tenacity that it surpasses the best steel armor plates. The melted mixture is cast in block and is perfectly malleable. To obtain a white metal that can be rolled out in sheets the above alloy is melted again, and twenty or twenty-five per cent of zinc and white metal added, which impparts to it the desired quality. A plate of the first-named alloy, two inches thick, was found by experiment to offer more resistance to a cannon ball than a steel armor-plate of the same thickness. This new kind of "white bronze" is not to be confounded with the alloy used in this country under same name for monuments. The latter consists principally of zinc.

WATER.

THE Eau Claire, Wis., Water Works company was organized on April 10th with the following officers-elect: President, O. H. Ingram, Eau Claire; vice president, C. H. Morse, Chicago; secretary and treasurer, C. A. Sharp, Chicago; directors, O. H. Ingram, C. H. Morse, J. G. Thorp, M. M. Moore, A. M. Gilbert; trustee, M. R. Coffin, Eau Claire; superintendent of water-works, W. H. Willard.

The capital stock is $100,000, of which 20 per cent has been paid in. Work will begin May 1st.

THE Laconia, N. H. Water Co. expect to have their works finished early in the coming fall.

PIERRE'S, Dakota, proposed water-works system, it is estimated, will cost $60,000.

RAPID CITY, Dakota, has decided to issue $45,000 in bonds to build water-works.

THE proposition to bond Bismarck for $100,000 for water-works was defeated at the city election recently.

THE Water & Gas Works Construction Co., of Pittsburg, Pa., has signed a contract for laying water pipe at Eau Claire, Wis. There will be 17 miles of pipe, from 4 to 14 inches, 200 fire hydrants, 150 valves, etc.

THE citizens of Albany, N. Y., have agreed upon a bill allowing the city to bond itself for $120,000 to secure a water supply from another source than the Hudson River. The bill has been ordered to a third reading by the N. Y. Senate.

THE Water Supply bill, to authorize Philadelphia to borrow $3,000,000, passed the Penna., House finally, on April 14, by a vote of 119 to 36. The opposition to the proposed loan at one time developed unexpected strength.

CAPT. MCKAY of Chicago declares that no drift of sewage from the mouth of the Chicago River get into the crib, as the new breakwater creates counter-currents by which the entire outflow of the river is carried in other directions.

THE Mount Pleasant city council of Iowa has refused to accept the system of water-works put in there by George B. Inman, and to pay for the use of the fire-hydrants, according to their contract. The water company has employed attorneys to enforce the contract.

THE *Daily American*, of Nashville, Tenn., says that the water-works of Jackson, Tenn., will be ready to supply the city with water in a few days. The supply of water will come from a system of tube wells sunk 30 feet in the Forked Deer bottom, reaching below the bed of the river. Nine wells have been sunk. The water actually flows out of the tubes clear as crystal.

AN extra engine of great power has been added to the machinery of the Water-works at New Albany, Ky. This will provide the company against all accidents from broken machinery, giving it a reserve engine of the latest and best pattern, that may be adjusted to any desired steam pressure; and that, in its construction, adds the Holly system to the very superior reservoir system of the company.

THE city officials of Brooklyn, N. Y., have about completed the details for the purchase of a strip of land from 60 to 100 feet wide, extending from Rockville Center to South Oyster Bay, ten miles, for the proposed extension of the water-works. The purchase and the work required will cost about $4,000,000. When the work is completed the water supply will be increased to 60,000,000 gallons a day. The city is authorized to issue bonds for the work.

PHILADELPHIA Councils, on April 16th, discussed the proposed water loan of $3,000,000, a bill for which is now before the Pa., Legislature. The objections advanced were that it could only be applied to bringing water from the Schuylkill River, the bill being specific in its application. A resolution asking the Legislature not to pass the bill until the Philadelphia Councils had fully considered it was finally passed—after a bitter debate on the ultimate appropriation of the money and the increase in taxes.

MAJ. LUDLOW, Chief Engineer of the Philadelphia Water Department, delivered on the 15th a lecture on the Future Water Supply of Philadelphia, before the Franklin Institute. He referred especially to the extensive surveys now being made by the Department in connection with the future supply. Maj. Ludlow considered that the cost of obtaining water from the Delaware River had been largely overestimated, being placed at from $20,000,000 to $30,000,000; and the Perkiomen scheme by the same estimates was to cost from $10,000,000 to $12,000,000. The recent surveys, as affording more correct data, have developed the fact that a supply from the Perkiomen can be secured for an expenditure of $6,300,000; this would build a conduit 28½ miles long and 12 feet in diameter; and with a fall of one foot in 6,000 feet this conduit would bring to the city 210,000,000 gallons daily, a supply sufficient for fifty years. By tapping the Delaware River at Point Pleasant, half way between Trenton and Easton, a remarkable pure supply could be obtained for $7,000,000, and there is always a flow in the Delaware past the Point, of one thousand million gallons per day. No reference is made in the report of this lecture as to the head under which either supply would be delivered, or whether the Delaware scheme included pumpage to obtain the requisite pressure in the city. As the report is understood, the estimates refer only to the bare cost of the conduits. In speaking of the Schuylkill water, Maj. Ludlow gives it a bad character; saying it would be on the average drinkable were it not for the large population on its banks. He said that the daily flow of the Schuylkill, fifty years ago, was 500,000,000 gallons, to-day it is but half that; and the speaker charged this fact to the oft-mooted forest denundation.

THE Ohio Legislature on April 13th, authorized Brooklyn, Cuyahoga Co. to issue bonds for water-works.

HUNTINGTON, April 15th.—It is rumored that the recent proposition of Peter Herdic to build water-works for this city was made merely for the purpose of allaying opposition to the abandonment of the Pennsylvania Canal, from which the water supply is now obtained in case of fire. It is further alleged that Herdic is acting at the instance of interested parties, who wish to make the people believe that the canal will no longer be needed for that purpose, and that, as soon as the bill now pending in the Legislature authorizing its abandonment is passed, the water-works project will be at an end. When Herdic was here he said he was then about starting to California and would not return until after the 30th instant, when his proposition is to be voted upon.—Phila. *Press*.

THE Holly water-works at Sioux City were officially tested lately. Four streams were thrown at the same time to a height of 150, 140, 158, and 161. The water supply is obtained from a drive well, into which, during the test, the water came as fast as it was pumped. The contract was for two Holly-Gaskill pumping engines, with 10-inch high pressure and 20 inch low pressure cylinders, and 18-inch stroke, the two to have a daily capacity of 1,500,000 gallons. The company, understanding that a high reservoir was to be used, made special patterns for the Sioux City pumps, causing delay in delivering. But the pumps furnished were enough better to pay for waiting, having 14-inch high, and 24-inch low pressure cylinders and 24-inch stroke. Sioux City paid $18,400 for pumping plant complete, including boilers.

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

Rapid Tunneling.—One of the engineers of the South Penn. R. R., incidentally writes on April 20th that "the drive last week in the west heading of the Alleghany Mt. Tunnel was 82 feet."

The Hartford & Harlem Railway Company has organized to build a line from Harlem River to Hartford via New Haven. Operations will be commenced in June.

Telegraphing from Trains while Running.—Further successful tests have just been made of the Phelps system on the Port Morris branch of the N. Y., N. H. & H. R. R. Despatches were sent and received while the train was going at a rate of 30 miles per hour.

Luminous Mile-posts.—On the cape of Good Hope railways, where the ruling gradient is 132 feet per mile, and changes of grade are very frequent, it is proposed that the figures on the mileage and on gradient posts should be painted in luminous paint, so as to be visible to the engineers and brakemen by night as well as by day.

New York Public Work.—The *City Record* for this week contains invitations to bid on the erection of foundation walls, and granite coping, steps, etc. for Jeanette Park and Morning Side Park; for addition to the "Tombs" prison; for lodge and iron railing at Bellevue Hospital; for tubular boilers and water heaters at Blackwell and Hart's Island.

The Wichita Bridge.—WICHITA FALLS, TEX., April 16th.—The railroad bridge across the Wichita on the Fort Worth and Denver City Extension was completed to-day and thoroughly tested by Chief Engineer A. P. Law and Contractor A. S. Hayne. They used three engines and a train of cars, heavily loaded with steel rails. It showed a deflection of less than half an inch.

The Susquehanna & Mahoning R. R.—A charter was issued on the 7th inst., to the Susquehanna and Mahoning Railroad Company, to construct a line from the mouth of Big Run, Jefferson county, Pa., to a point on Little Clearfield creek, Clearfield county, Pa., a distance of 15 miles. The capital stock is $150,000. W. N. Betts, of Clearfield, is president, and all the stockholders are from that town.

New Pan-handle Bridge.—Civil Engineer Johnston, of the C., St. L. & P., is in Logansport, locating the site of the new Panhandle railroad bridge, which is to be constructed over the Wabash river in the place of the old one now used by the company. It is thought that the new bridge, which has been in contemplation for some time, will be built during the present season.

Cleaning Ash-pans while Running.—A mechanic in the Michigan Central shops is the inventor of a device for cleaning the ash-pans of locomotives while running at full speed. It consists of a piece of gas pipe which runs from the rear of the boiler down through the floor of the cab, entering the ash-pan through the side. By turning a cock in the cab, a jet of stream of 140 pounds pressure is turned loose in the ash-pan, and the contents, consisting of ashes, cinders, snow, or anything else movable, is readily cleaned. The right to use the devise on the G. R. & I., has been sold for $1,000.

The Knoxville, Sevierville and Pigeon River Railroad Company has been organized for the construction and operation of a road from Knoxville to Sevierville and thence to the State line between Tennessee and North Carolina, where it crosses the Big Pigeon River.

A Railway from Minneapolis to St. Paul.—At a meeting of the St. Paul & Northern Pacific railroad directors it was determined to construct a road from Minneapolis to St. Paul. The cost of the road will be about $1,125,000, including the right of way, which has already been secured, and a permanent bridge. The Northern Pacific owns a majority of the stock of the St. Paul & Northern Pacific.

Georgia Railway Organization.—A new Georgia railroad company has a major for president, a colonel—rather in contravention of military rank—for vice-president, colonels for treasurer and chief engineer, and a captain for secretary. The board of directors includes two captains, three majors, four colonels, two judges and one solitary untitled citizen, who must feel awfully lonesome. It is reported, however, that the untitled citizen aforesaid furnishes nearly all the capital, the colonels, etc., taking a share or two each.

Proposed Road from Portland to Chicago.—It is authoritively announced that a new through line from Portland to Chicago will soon be effected by the Boston & Lowell Railroad, via the St. Johnsbury & Lake Champlain Railroad. This is the same line which was announced for last summer, but which was then broken by the Vermont Central. The St. Johnsbury *Republican* asserts that the repair shops, the removal of which to Woodsville was reported to have been begun last week, will remain at St. Johnsbury for the present.

Public Works of St. Paul, Minn.—Mayor Hillsbury in his address to Councils on April 14th, referred as follows to the late city improvements: Since the incorporation of the city, $1 764.055 has been expended under the direction of the City Engineer. Of this amount $552,465 has been invested in sewers; $368,575 in pavements; $184,162 in stone sidewalks, and $84,435 in curbs and gutters. The balance was mostly expended in bridges. The water-works have cost to date, $803,474.56, and the running expenses for 1884 were $41,864.22; the receipts for water rent for same period were $84,215.24.

To prevent Derailment.—Major A. Poulson, an old western passenger agent, has recently patented a device which is claimed to be a sure protection against the derailment of trains in turning even the sharpest curve at a high rate of speed. The contrivance consists of a T-shaped iron clamp, secured to the bottom of the car and fitting into a grooved rail placed midway between the track-rails. The clamp is adjusted by a lever worked by the engineer. It is said that the appliance is about to be adopted by the Southern Pacific on its passenger cars.

Electric Light on a German R. R.—Some trains on the Frankfort-Fulda-Ulm Line are now fitted up with a dynamo placed in the baggage car on one side and accumulators on the other side. The dynamo, if driven at 750 revolutions, gives a current of twelve amperes, which by an automatic switch is sent into the accumulators. The dynamo is driven from one of the axles of the van, in a similar manner to the plan adopted on the London, Brighton and South Coast trains. The cost of installing the plant is given at $600 for dynamo, driving gear, and accumulators, and at $16 to $20 per passenger coach. The light itself is estimated to cost 1.7 cents per lamp hour.

Railway Surveys in Siam.—The railway survey of Siam between Bangkok and Korat, a distance of about 200 miles, is being rapidly pushed forward by the engineers, Messrs. Murray & Drysdale, on behalf of Messrs. Tanered, Falkner & Co., of London. The Siamese Government has promised the land, etc., necessary for the line. The further surveys for the Siam-Burmah Railways under Mr. Hallett will proceed next cold weather. These main lines will not merely develop the country, but will prove of great strategetic value, a fact which no doubt has largely induced the Siamese Government to take so lively an interest in the introduction of railways, in this following the example of China.

Suakim—Berber R. R.—The mere weight of rails, sleepers and plates required in the construction of the Berber-Suakim Railway is 45,000 tons, which must be conveyed on an average 120 miles. Assuming a camels load to be one-fifth of a ton, and a camel to march ten miles, it would require 7,400 camel-loads daily to complete the carriage within the year. Moreover, there exists nothing but the roughest aneroid survey of the section of the country to be traversed. In the first sixty miles there is an ascent of 2,870 feet while in the remaining 180 miles there is a descent of 1,730 feet, but the ascent and descent are by no means continuous and gradual. The railway had reached Handoub on April 16th.

The Canadian Pacific.—In the House of Commons, April 16th, Sir Leonard Tilley, Minister of Finance, said it was estimated that $660,000 will be required to complete the Government sections of the Canada Pacific Railway.

Mr. Blake asked for particulars of the arrangement to be made with the Canada Pacific, and said he had received information that, that portion of the railway line in the Rocky Mountains had been changed in consequence of avalanches, and that the deflection would increase the length of the road three miles.

Mr. Pope, Minister of Agriculture, said the gentleman's information was correct. The movement of glaciers and avalanches had been watched, and it was found that the route first agreed upon was impracticable, but a new line had not been finally decided upon.

Contracts for Steel Rails.—An interesting petition was filed in the Ore and Steel Company receivership, April 16th, by the Lackawanna Ore and Steel Company. The intervenor contracted with the St. Louis Ore and Steel Company to furnish steel rails at $25 per ton, and upon securing this favorable contract the Vulcan Iron Works were shut down, and the rails ordered to fill existing contracts from the Lackawanna. There were delivered rails amounting to $1,500 per month, and there still remains unpaid on this amount $58,000. The intervenors ask to recover this amount, and $23,000, the difference between the market price of the unpaid-for rails and the contract price. The petition was referred to the master.

The New York and Brooklyn Bridge.—The Treasurer reports for the month of March, 1885, as follows:—Foot passengers, 291,538; car passengers, 1,353,557; vehicles, 73,333 with 148,666 passengers (estimated). The total receipts for the month were $47,404.67. The total expenses were $37,169.44, including in this $5,500 for new machinery and supplies. The average daily receipts were, for promenade, $42.86; railroad, 1180.09; carriageway, $149.86, a total of $1372.81. As compared with the receipts for March 1884, there is a total decrease of $2,699.83, or $\frac{95}{100}$ per cent; the increase in passengers was however 591,515 over same month in 1884, or $56\frac{15}{100}$ per cent. The foot-passengers have decreased $8\frac{44}{100}$ per cent. over 1884, and the car traffic has increased $84\frac{15}{100}$ per cent. Only 42,513 vehicles passed over the bridge in March, 1884. The profits on the bridge traffic for the nine months, from June 1, 1884, to Feb. 28, 1885, were $.01.734, 15.

The North Pacific.—PORTLAND, OR., Special, April 6.—The Northern Pacific has now advanced on the Cascade division eighty-seven miles from the Columbia northwesterly toward Puget sound. The track has been laid to a point about a mile north of the newly laid out town of North Yakima, to the first crossing of the Takima river. Up to that point the work has been comparatively light and easy, but beyond there are very heavy grades and many obstacles will be encountered. Contracts have just been let the 125-mile post, westward from Ainsworth—near the town of Ellensburg, in the Kittitas valley. The agents of the Northern Pacific say the road will be immediately finished across the mountains to tide water. The mountain work will be very heavy and difficult, and there is a general fear that if the Northern Pacific leases the Oregon Railway and Navigation company's lines the work will be postponed.

New Snow-Plow.—J. J. Wheat, of Indianapolis, is the originator of a snow-plow to be constructed on entirely new principles. On the front end of a flat-car rests a box of boiler-iron eight feet wide and high enough to reach from five inches above the track to the top of an ordinary passenger coach. This box runs back eight feet and is gradually reduced, funnel-like, to a circular opening six feet in diameter, in which revolves an exhaust fan at a high rate of speed, run by a double-acting stationary engine resting on the same car. From the fan a six-foot in diameter discharge-pipe runs back on the car ten feet, when it curves to one side, projecting beyond the edge of the car about four feet. Mr. Wheat claims that, with a couple of good locomotives to push the plow, he can go through ten foot snow at a rate of thirty miles an hour, taking the snow in at front, drawing it through the fan, and forcing it out through the outlet pipe, throwing it forty feet, on either side of the track, entirely out of the way. The box being only eight feet wide, wing attachments a foot wide are placed on each side, thus compressing the snow for that distance, making a solid wall, and widening the passage to ten feet, which would allow free running of passenger trains. The roadmaster of a prominent Indianapolis road is engaged with Mr. Wheat in perfecting arrangements to build one of the plows at once.

The Narrow-gauge Discussed in Paris.—A long discussion took place at a recent meeting of the Paris Civil Engineers' Society with regard to the merits and demerits of the narrow-gauge. M. Moreau believed that it was amply sufficient wherever the traffic did not exceed 50,000 francs per kilometer. There should not be too many sizes, however; the maximum should be 39 inches and the minimum 29½ inches. He considered that the economy gained was from 40 to 50 per cent. on the bed road, 35 to 40 on the superstructure, and from 30 to 35 per cent. on the rolling stock. Very little transferring was ever done on local lines. Even in France four tons of dead weight have to be carried to one live

ton (in England the proportion is eight to one). The narrow-gauge, he maintained, offered security, efficiency and economy, and the Minister of Public Works has now decided that only narrow-gauge roads shall be built in future. So far as France is concerned, there is no longer any room for a broad-gauge. M. Roy thought that the only factor that would permit a reduction in the radii of curves would be a reduction in the dimensions of the rolling stock, the governing part being the shearing angle produced by the flange of the wheel-tire in contact with the frog-rail. He is the inventor of an articulated system of rolling stock that would enable the broad-gauge cars to run on the curve of the narrow-gauge.

The Forth Birdge Railway.—The eighth quarterly report of inspection by Major-General Hutchinson, R. E., and Major Marindin, R. E., of the works in progress for the construction of the bridge over the River Forth, as given in a recently issued parliamentary paper, is substantially as follows:—

Temporary Works at South Queensferry.—Two temporary bridges have been thrown across the North British Railway. New drawing offices and a drawing loft are in course of construction; and new drill roads are being laid down.

At Inch Garvie.—The iron staging for the two unfinished deep water caissons is being carried forward into the deep water.

At North Queensferry.—An iron caisson is now being made for the purpose of levelling the deeper portion of the rock with the aid of compressed air.

Permanent Works at South Queensferry.—The viaduct piers are all ready for the reception of the girders, except No. 9. Two (the south-west and south-east) of the 70 feet diameter caissons have been successfully sunk to the contract depth in hard boulder clay. In the south-west caisson the whole of the concrete work has been completed. The south-east caisson is filled with concrete to within 8 feet of low water mark, at which mark, the masonry will commence. Considerable progress has been made with the steel superstructure of the viaduct.

At Inch Garvie.—The masonry of the north east pier is finished, and that of the north-west pier is about 11 feet above high water mark, or 7 feet below the level of the bed plate.

At North Queensferry.—The masonry of the north-east, north-west, and south-west piers is finished; the bed plate has been fixed on the north-west pier, and those on the north-east and south-west piers are being fixed. Two spans of the viaduct girders have been completed; one is finished with the exception of the floor, and two others are in progress. About 6,800 tons of steel work for the superstructure of the large spans are in various stages of preparation in the shops. The portions most advanced are the bed plates, skewbacks, tubes, and girders for the North Queensferry cantilevers The number of men employed on the works is about 2,000, including the Italians engaged in the compressed air sinking arrangements.

Contracting.

Box Car Contract.—The Lafayette, Indiana, car works are building four hundred box-cars for the Louisville, New Albany & Chicago road, also twenty-five refrigerator cars.

Ohio Canal work.—The $130,000 appropriated by the Senate for the canals is divided as follows: Miami & Erie Canal, $35,000; Ohio Canal, northern division, $25,000; Ohio Canal, southern division, $45,000; Muskingum improvement, $25,000.

Wisconsin R. R. Contract Let.—F. G. Winston, of Minneapolis has taken the contract to grade the railroad from River Falls to Ellsworth, Wisconsin to have it done by the 1st of September. He expects to have two hundred teams at work along the line soon.

R. R. Work to be Let.—The Wilmington and Weldon Railroad Company invite proposals for the graduation, masonry and trestle upon that part of their new road between Contentnea bridge, near Wilson, and Fayetteville, 70 miles in length.

Phila. Intercepting Sewer Commenced.—The construction of the intercepting sewer on the East side of the Schuylkill River was started recently between South Laurel Hill Cemetery and the Richmond branch of the Reading Railroad Company. This work will continue all summer and travel on the river road north of Strawberry Mansion will be blocked, leaving Ridge Avenue as the only route open to Manayunk.

A Proposed Big Tunnel in Chicago.—As a remedy against the bridge nuisance, Commissioner Cregier has planned an immense tunnel under Chicago river, at the junction of the main streams and branches, opening into Fulton street on the west side and Market street in the north and south divisions. The cost is estimated at $1,200,000.

La Salle R. R. Contract.—Langdon & Co. of St. Paul have been awarded a contract by the Northwestern for grading the road from Belvidere, on the Freeport division, south to Peru, La Salle county, a distance of about seventy-five miles. The road is to be built this summer, and will be used to supply coal to the Northern and Western divisions.

Boston Sewers.—The Superintendent of Sewers, o Boston, Mass., reports that $336,542.06 were expended on sewer-work in 1884, being a total of about 14½ miles There are now 236 miles of sewers in the city.

The East River Tunnel Company, which proposes to build a tunnel under the East River from Ravenswood, Long Island, to a point in New York between Thirty-seventh and Fifty-second streets, have made arrangements with the Merritt Coast Wrecking Company for the use of vessels and divers to make a complete survey and examinations of the bed of the river where it is intended to cut the tunnel through.

Government Bids.—Upon this question whether, in considering bids made on perfectly similar lists of material, the lowest *aggregate* bid should be accepted, or should similar items in the different bids be compared, and the bidders be required to furnish the items thus selected, the Secretary of War decides that, in the absence of a fixed standard for all the articles bid for, advertisements and circulars should be so worded as to permit the award for the most suitable article offered for the purpose required, and the bids should be considered item by item (Letter A. G. O., March 26 1885.)

The Pipe Canal of Manchester, England.—LONDON, April 15th.—The committee of the House of Lords which has had the Manchester pipe canal project under consideration for several months have decided in favor of the scheme so far as its engineering problems are concerned.

The committee, however, reserved decision as to the commercial advantages of the undertaking, and have resolved to make an immediate and thorough investigation into this branch of the subject.

To dredge Charleston Bar.—The steam lighter Howard, of Newark, is being prepared for an experiment. A large box and pumps are being built on her deck, and when completed she will go to Charlestown harbor and make an experiment of dredging the sand from the bar by means of the pumps. When the deck is loaded she will steam outside the harbor and dump it overboard. The experiment will be watched with considerable interest, as the success of the scheme is very much doubted.

Pottsville, Pa., R. R. Contracts Let.—POTTSVILLE, Pa., April 14.—There were thirty bidders to-day for the contracts for work on the Pottsville and Mahoney Road. Drake, Stratton & Co., of New York; Thomas F. Kerns, Pottsville and E. J. Gaynor, Pottsville, and Timothy Caven, Washington, were the successful ones. The sections awarded to-day will complete all of the road except six miles. At the same time all but four miles of the Reading and Pottsville line was given out, Abraham Keller, of Lancaster, Nolan & O'Reilly, Reading; John T. Dyer, Norristown; Kennedy, Crossen, Keller & Bach, and Charles McFadden being the successful bidders.

Toronto Public Work.—The City Engineer of Toronto, Canada, reports that in 1884, $575,689.31 was expended for public work in that city. Of this about $275,000 was expended on roadways; $131,236, on sewers, and $126,000 for general street purposes. There are now 107.25 miles of sewers in the city, and 164 miles of streets. During the year 8.42 miles of cedar-block pavement were built. The cedar block already laid is showing signs of rapid wear, and the engineer recommends a more durable material on the main traffic streets. 131 miles of streets have been paved since 1881, and of this 33.85 miles are laid with cedar block.

Granite Paving Blocks.—The following bids were made April 15th, at the office of the Commissioners for furnishing 500,000 granite paving blocks: New York and Maine Granite Company's, $39.90 per thousand; Virginia State Granite Company, $41 per thousand; F. H. Smith, $42 per thousand; Richmond Granite Company, $43.75 per thousand, and John Booth, $10.50. Bids were also received for laying 60,000 square yards of sheet asphalt and asphalt block pavement. The bidders were H. L. Cranford and The Barbour Asphalt Paving Company, and the bids ranged from $2.28 to $2.38 per square yard. Patrick Maloney offered to lay the asphalt block pavement on a limited number of streets for $2.10 per square yard.

Bridge at New Baltimore, N. Y.—On April 15th, the following bids were opened for constructing an iron highway bridge at New Baltimore, N. Y. The bridge consists of one span, ninety-five feet in the clear, roadway fourteen feet wide, iron floor beams and joists, 2¼ inch oak floor plank, moving load 80 pounds per square foot.

Albany Bridge and Iron Works (low truss)	$1360.00
Riverside Bridge Co., (wooden joists)	1365.00
King Iron Bridge and Manufacturing Co	1366.88
Wrought-Iron Bridge Co., Canton, O	1370.00
Penn Bridge Works	1460.00
Berlin Iron Bridge Co	1500.00
Groton Bridge Co	1550.00
Hudson Bridge Co	1620.00
Hilton Bridge Construction Co	1674.00
Morse Bridge Co	1685.00

It being considered desirable to have a high truss bridge, the contract was let to the King Iron Bridge Manufacturing Co., they being the lowest bidders for that style of structure.

Cincinnati to be paved.—Mr. Stryker's bill authorizing Cincinnati to issue $2,000,000 worth of bonds to pave the streets with granite or asphalt was passed in the Ohio Senate.

The Severn Tunnel.—This year will see the completion of one of the greatest submarine engineering feats ever undertaken in Britain. Severn tunnel was first begun by the Great Western Railway sixteen years ago, and the accomplishment of the great work has been delayed by difficulties which a few years back would have been thought insurmountable. Twice has an enormous volume of water flooded the works, through the accidental tapping of land springs; besides which, fissures in the rock were met with which let the tidal waters into the tunnel. The river is two and a quarter miles broad at the site of the works, but the tunnel itself is nearly double that length, in order to allow for the necessary gradient on either side, the crown of the tunnel being fifty feet below the deepest part of the river. The enterprise has cost considerably more than a million sterling.

Cleveland, O., Bids for Repaving.—Engineer Force has the following bids for repaving Superior street, which will be submitted to the Board of Improvements as soon as it is organized for business: From north Perry to Hoadly street, 6,500 feet excavation, 24,654 cubic yards; paving with common Medina stone, 303,426 square feet; curbing, 15,788 lineal feet; crosswalks, 10,708 lineal feet. Luke Brennan, $71,388.49; Claflin Paving Company, $73,915.81; A. R. Jewett, $83,148.70; A. H. Delamater, $93,385.95; Campbell Brothers, $95,079.48. From Hoadly street to Wilson avenue, 1,650 feet; excavation, 9,488 yards; block Medina stone pavement, 73,616 square feet; curbing 3,548 lineal feet; crosswalks, 2,718 lineal feet. Claflin Paving Company, $28,989.12; Luke Brennan, $29,139.30; A. H. Delamater, $30,026; A. R. Jewett, $32,032.10; Campbell Brothers, $32,247.66.

Atlanta, Ga., Paving Bids.—The following table gives a comparison between the bids of 1884 and 1885 for street paving, etc., per square yard:

BIDDER			Price for 1885.	Price for 1884.
Granite Blocks, Venable			$1.85	$ 2.09
Rubble Paving, St. Mt. Co			.97½	1.09
Curbing, G. W. Johnson			.29	.37
Crossings,	do		.29	.40
Grading sidewalks, F. P. Rice			.15	.21
Lay'g Brick Sidewalks	do		.34½	.45
Brick Sewers	do		10.64	12.98
	12 in.	15 in.	18 in.	24 in.
Pipe sewer, P. J. Fallon	30	50	65	$1.15
Rubble masonry	do $2.65 & $3.00			

Miscellaneous.

The Niagara Reservation Bill has passed the N. Y. Senate. It provides for a free park around Niagara Falls forever, and makes an appropriation for the purchase of the land.

The City Debt of Cleveland, O.—The present total indebtedness of Cleveland is $7,313,997.55, the increase in which over former years is attributable to the extensive character of recent city improvements, such as large main sewers, the Kingsbury Run viaduct, and a large amount of stone paving and other work that was necessary.

Transportation in St. Domingo is still in its primitive condition. There is not a single wagon road penetrating more than three or four leagues into the interior. All of the inland traffic is carried on by means of animals. A railroad is being built from Samana bay to Santiago, and if completed will open up rich tracts of lands capable of producing great crops of sugar, tobacco, coffee, cocoa, and other tropical articles.

The Statue Coming.—The French frigate Isere, will leave Rouen for New York about the end of April, with Bartholdi's statue of liberty enlightening the world. United States Minister Morton and John W. Mackey have headed a subscription to the fund to be raised by the Americans for the purchase of the cast of the model of the statue to be erected near the United States embassy in Paris. The cost will be $20,000.

The Right to name an Asteroid.—Herr Palisa of the Vienna Observatory, needing funds for an expedition he has projected to observe the total eclipse of the sun in August, 1886, announces that he puts up for sale, at 1,250 francs, the right to bestow a name on the asteroid No. 244, his last discovery. This is the first opportunity that lovers have ever had to get a star named after their sweethearts.

The 110-ton Gun.—The British Government have ordered three 110-ton guns, and of these one is to be delivered in October next, another in January, and the third in April, 1886. The price per gun is £19,500; the weight of the projectile is 1,800 pounds; the charge is 200 pounds of cocoa powder; the muzzle velocity is 2,020 feet per second; the maximum powder pressure is 17 tons per square inch. The velocity and pressure are, of course, only estimated, although they are based on the experience gained with the Italian guns.

Melting old Steel Rails.—The Columbus, Ga., iron works has just succeeded in accomplishing another feat heretofore unknown to foundrymen—that of melting old steel rails in an ordinary cupola and making them into brake shoes for use on the Mobile and Girard railroad.—*Ex.*

New York Harbor to be Surveyed.—At a meeting of the Pilot Commissioners on April 14th Secretary Nash read a communication from Superintendent J. E. Hilgard of the United States Coast Survey, announcing that a thorough resurvey of this harbor had been decided upon. This survey would cover all portions of the Bay and harbor, including the East River and Throgg's Neck. Assistant Hergesheimer would at once begin preliminary work in the East River. Three vessels were being fitted up for this work, and two steamers, now engaged in Southern waters, were under orders to come to this port for this purpose.

What might result from a Mistake in Figures.—Several years ago it was discovered that a slight error had been made in the calculation of the sun's distance from the earth, and owing to a misplaced logarithum, or something of the kind, a mistake of 3,000,000 miles was made in the result. People cannot be too careful in such matters. Supposing that on the strength of the information contained in the old-time table, a man should start out with only provisions sufficent to take him 89,000,000 miles, and should then find that 3,000,000 miles still stretched out ahead of him. He would then have to buy fresh figs of the train boy in order to sustain life. Think of buying nice fresh figs on a train that had been en route 250 years! Imagine a train boy starting out at 10 years of age and perishing at the age of 60 with only one-fifth of his journey accomplished. Think of five train boys, one after another, dying of old age on the way, and the train at last pulling slowly into the depot with not a living thing on board except the worms in the "nice eating apples!"—Bill Nye, in the Cleveland *Leader*.

Future of the Iron Trade.—James M. Swank, the secretary of the American Iron and Steel Association, in referring to the iron trade, said that the future must see its improvement. How soon that would come depended entirely upon the improvement in general trade, and especially in the business of the railroad companies. Prices for iron and steel were now about where they were in December and January, and had apparently reached bottom. There was no likelihood of their going lower. Business was light and at figures that did not yield much if any profit to the manufacturers The railroad companies, which consume one half of all the manufactured iron and steel produced in this country, were cutting down expenses, and are not giving out orders. There was very little building of new roads, and the demand for rails, car wheels, and locomotive iron was of necessity at a low ebb. In the event of war in Europe, Mr. Swank says an increased demand for grain from this country would of course follow. An improvement in the iron trade would then be the indirect result. Increased business would fall to the railroad companies through the transportation of this grain, and their consequent increased expenditures for new rolling stock, improvements to their lines, etc., would start a boom in iron and steel.

Index to Periodical Literature.

Armor Plates.—*The question of Armor Plates.* A very full and inter sting account of the series of tests of armor plates carried on at Spezia, 1882, '83, Shoeburyness, 1883, Copenhagen, 1884, and Spezia, 1884. Three kinds of plates were used, Schneiders steel and Cammelis and Brown's compound plates. The effects of projectiles from 100-ton guns are shown by many diagrams. Compiled from many sources by the *Army and Navy Journal*, April 4, 1885, pp. 707 to 730.

Bridge—Attock.—*Le Pont sur l' Indus a Attock.* Detailed description of the erection of this bridge on the Puirjaut Northern State R. R. There are five spans, three of 77 metres (about 252',) and two of 93.6 metres (about 307'.) The trusses are of the Linville type. The piers are formed of 8 wrought-iron columns, braced horizontally, and on the faces with latticed struts and tie-rods. The false-works for the river span were composed of two fan-shaped timber structures, springing from the piers, and nearly meeting over the center of the river. The cost of the structure, in detail, is given, and a table showing the results of the tests. The article is very fully illustrated. *Le Genie Civil.* March 14, 1885, pp. 309 to 312.

Bridge Strains.—*Positions of Live Load giving Maximum Strains for single Intersection Trusses.* An analytical solution for determining position of live load giving maximnm moments and maximum shear, and method of computing stresses in chord and web members; with tables. By Wm. Cain. *Van Nostrand's.* March, 1885, pp. 193 to 200.

Cities, Growth of.—*Commercial Cities: the Law of their Birth and Growth.* The writer maintains the proposition that "the commercial port of a region will be as close to the producer as it is possible to go, and obtain reasonable good facilities for the class of transportation demanded by the produce of the county." The paper with its discussion has a bearing on the unsuccessful efforts made by railroad capitalists to build commercial ports. By A. F. Sears; with discussion. *Trans. Am. Soc. Civ. Engineers.* Jan. 1885, pp. 19 to 36.

Drainage Sluices, *see* **Sluices, Drainage.**

Engine, Soda.—*Honigmoun's Caustic Soda Condenser* Account of several interesting experiments recently made in Germany. The results of a series of tests made with an old locomotive specially fitted up for the purpose are said to be very encouraging. Illustrations are given of the locomotive, stationary concentration plant, temperature, curves etc. *Engineering.* Feb. 27, 1885, pp. 225, 226.

Ferry, Railroad.—*Danish Railway Ferries "Korsör" and "Nyborg."* A description, with illustrations of the two large R. R. ferry-boats built for the Danish government. The hulls are of steel, 268 feet 10 inches long, and 1,187 tons displacement; they carry 17 loaded freight or 13 passenger cars. They are built not only to withstand severe weather in the open sea, but also to break through ice. They are double-enders, and have a speed of 13 knots. Constructed in Sweden. *Engineering.* Aug. 22, 1884, p. 176.

Harbor of Refuge, Peterhead.—*Proposed Harbor of Refuge at Peterhead (Scotland).* Adverse criticism of the action of the committee in selecting the location of this harbor, with some remarks on the principles which should guide in the selections of sites for harbors of refuge. The engineering features of the proposed piers—designed by Messrs. Stevenson—are also adversely commented on. The base is of concrete blocks, *pierre perdue*, which the writer does not believe will stand the sea. Illustrated. *Engineering.* Aug. 22, 1884, pp. 170 to 172.

Hydraulics, *see* **Water, Flow of.**

Locomotive Efficiency, *see* **Train Resistance.**

Locomotive, Fireless. *see* **Engine, Soda.**

Railroad, Arabian.—*The Shortest Route to India.* A study of a porposed trans-Arabian railway from Port Said to the Persian Gulf. A description of the route, difficulties in the way of construction, the cost of construction traffic, maintenance, etc. *Contract Journal.* April 8, 1885, pp. 427 to 429.

Railroad Guage Changing.—*Changing the Guage of Railroads while in operation.* A statement of the preliminary work necessary, and the order in which it is to be done, the preparation for the actual work, the force necessary, and the method of making the change with but slight interference with the train schedules. The special circular for narrow gauging the N. Y., P. and O. R. R. in 1880, is given in full, with some additional suggestions growing out of this work. The record of the work done on this occasion is given in tabular form. By Henry C. Thompson, Civ. Eng. Club, Cleveland. *Jour Assn. Eng. Societies.* April 1882, pp. 230 to 241.

Market Report of Engineering Materials.

New York, April 23, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

Structural Iron.		
Angles	2.c.	@ 2.2c.
Tee	2.25c.	@
Beams and channels	3.0c.	@ 3.5c.
Tank	2.1c.	@ 2.15c.
Shell	2¾c.	
Steel plates, Tank	2¾c.	@ 3c.
Wrought-iron Pipe.. Pittsburgh.		
Butt welded, black.....Discount	50	
" " galvanized..... "	40	
Lap welded black..... "	50	
" Galvanized..... "	67½	
Boiler tubes..... "	60	
Rails.		
Steel (large lots at mill)	$27.00	@ 27.50
Old rails	17.25	@ 17.50
Oldrails, steel	16.50	@ 17.50
R. R. spikes	1.8	@ 1.9c
R. R. splice-plates	1.65c.	@ 1.75c.
R. R. Track Bolts	2.6c.	@ 3c.
Barb-wire fencing, galvanized	4¾c.	@ 5¼c.
" " painted	3¾c.	@ 4¼c.
Corrugated iron		
Nails		
Iron	2.25	
Steel	2.35	

METALS.

Copper.		
Lake Superior	10 8	@ .11
Other Brands	10¼	@ 10¾
Lead.		
Com. Domestic	3.60	@ 3.70
Lead Pipe	.06¾	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.06¾	
Zinc.		
Sheet	5.00	@ 5.20

BRICK.

(Cargoes afloat)		
Haverstraw 1st.....per M.	$5.75	@ 6.25
" 2nd..... "	5.62	@ 5.87
Fishkill	4.75	@ 5.50
Up-River		
Jerseys	5.25	@
Long Island		
" pale		
Fronts.		
Croton red	14.00	@
" dark	14.00	@
" brown	12.00	@
Philadelphia pressed	22.50	@ 23.00
Trenton "	22.50	@ 23.00
Baltimore "	37.00	@ 41.00
Buff "	33.00	@ 35.00
Enameled English	65.00	@ 130.00
" American	85.00	@ 120.00
Fire brick	25.00	@ 40.00

CEMENT.

Portland.		
Gibb's English 400 lbs. per bbl	2.75	@ 2.90
K. B. & S. " "	2.85	@ 3.00
Burham " "	2.70	@ 2.85
Keene's fine " "	9.50	@ 9.75
" course " "	5.25	@ 5.75
Roman	2.75	@ 3.50
Langerdorfer German "	2.90	@ 2 65
Dyckerhoff, " "	2.60	@ 2.65
Stettiner " "	2.60	@ 2.65
Alsen, " "	2.55	@ 2.60
Fieve " "	2.40	@ 2.50
Saylor's American	2.15	@ 2.40
Rosendale cements	0.90	@ 1.10

LIME.

Rockland common per bbl	1.00	
" finishing	1.20	
Glensfalls, common	.85	
" finishing	1.05	@ 1.10
Kingston, ground	0.95	

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90	@ 95
" " No. 2 "	0.75	@ 0.80
" " light drab "	0.80	@ 0.95
Berlin " in rough "	0.75	@ 1.00
Berea " " "	0.75	@ 1.00
Brownstone, Portland, Ct. "	1.00	@ 1.30
" Belleville, N. J. "	0.75	@ 1.25
Granite, rough	0.60	@ 1.25
Common building stone per load	2.00	@ 3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@ 3.00

SLATE.

Purple roofing per square	6.00	@ 7.00
Green "	6.00	@ 7.00
Red "	15.00	
Black Penna. (at New York) "	4.50	@ 5.00

LUMBER.

Pine, Common box per M.	18.00	@ 20.00
" Good "		
" Tally plank, 1¼ in each.	.44	@ .50
" Tally boards, dressed com. "	.28	@ .30
Spruce, Boards dressed "	.25	@ .28
" Plank, 1¼ in "	.28	@ .30
" " 2 in. "	.38	@ .40
" " 2 in. dressed "	.43	@ .45
Timber per M.	20.00	@ 22.00
Hemlock, Boards each.	.18	@ .20
Joist, 2½ × 4 to 4 × 6 in	.17	@ .44
Oak per M.	55.00	@ 65.00
Cypress 1, 1¼, 2 and 2½ in "	35.00	@ 40.00
Yellow Pine, Girders "	26.00	@ 35.00
Dressed flooring "	30.00	@ 40.00
Shingles, Extra shaved pine, 16in. "		
" " sawed 18 in. "	4.50	@ 5.00
Lath, Cargo rate "	2.40	@ 2.50

PAINT.

Lead, white, American dry per lb	.04¾	@ .05
" " in oil pure "	.05¾	@ .05¾
English, B. B. in oil "	.08¾	@ .08¾
Red, American "	.05¾	@ .05¾
Litharge "	.05	@ .05¼
Venetian red, American "	.01	@ .01¾
Indian red "	.05	@ .10
Vermillion, American lead "	.11	@ .11½
Paris green "	.15	@ .19
Umber, Amer. raw and powdered per lb.	.01¼	@ .01½
Drop black, Amer. "	.08	@ .12
" " " "	.09	@ .11½
Chrome green "	.05	@ .15
Oxide zinc, American "	.03¼	@ .04
" French "	.06¼	@ .06½

To Purify the U. S. Treasury Buildings.—The Secretary of the Treasury has appointed Supervising Architect Bell and Surgeon-General Hamilton as a committee to devise a plan for immediately improving the sanitary condition and ventilation of the Treasury Building. The report of a chemist who recently made a careful examination of the building states that the sanitary requirements of ventilation are more completely ignored in the Treasury Department building than in any penitentiary in the United States.